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# The Luminescence Camera

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**Abstract**

AN instrument was designed and constructed for the purpose of causing the flashes of luminescence in the sea to trigger an underwater camera device and thus take photographs of the animals producing the flashes. A photomultiplier detector is utilized which, upon stimulation by the flash of a luminescent animal, triggers an electronic flash and camera combination. Simultaneously, a sonar pulse is emitted from an attached transducer, which announces that a picture has been taken and relays information to the surface concerning the depth of the instrument. After this the camera automatically advances its film to complete the cycle. The instrument described is entirely self-contained and requires only mechanical support from the cable to the surface. It has been designed to operate at any depth down to 6000 meters. The length of film used during each lowering is sufficient for 800 frames. The instrument was operated successfully during the summer of 1957 aboard the Research Vessel Crawford and the Coast Guard Cutter Yamacraw.

## General Design

This instrument was especially designed to investigate the light flashes previously observed by Clarke and Wertheim (1956), Clarke and Backus (1956), and Clarke and Hubbard (1958), while using the Bathyphotometer. Information from their work showed that the luminescence detector should be triggered by flashes with an irradiance of $10^{-5}$ u watts /cm$^2$ or greater in order to obtain a satisfactory number of photographs (Figure 1). Due to the high sensitivity

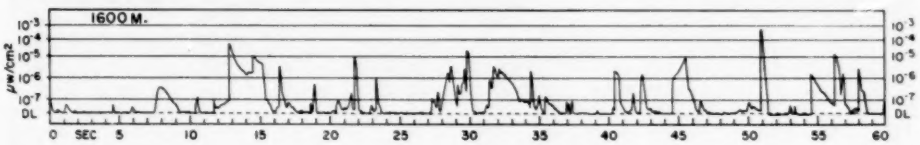


FIG. 1

demanded, a photomultiplier trigger was required. This was designed so as not to be injured by direct sunlight or by the light flash emitted from the electronic lamp. The circuits are so designed that only pulses of light are accepted. Provision is made for manual pre-selection of the threshold level of the photomultiplier trigger.

The instrument is entirely self-con-

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tained, thereby eliminating any dependence upon electrical conductors in the cable. The circuitry is such that the device can operate continuously for at least ten hours before the batteries need recharging. Mercury switches are employed so that the instrument can be loaded and stored in a prepared state.

The camera and film advancing circuitry are contained in one cylindrical housing, and the electronic flash and photomultiplier trigger are in another (Figure 2). These fit into a rigid cradle which fixes the overall geometry of the instrument. The cradle is so designed that each cylindrical house can be easily detached for facility in servicing and transportation.

Although the overall instrument is electrically self-contained, signals must be exchanged among its various units. Electrical pulses leave the flash unit, pass through the sonar, and then enter the camera unit. By utilizing the instrument ground, only one electrical lead-in is needed on each cylindrical housing.

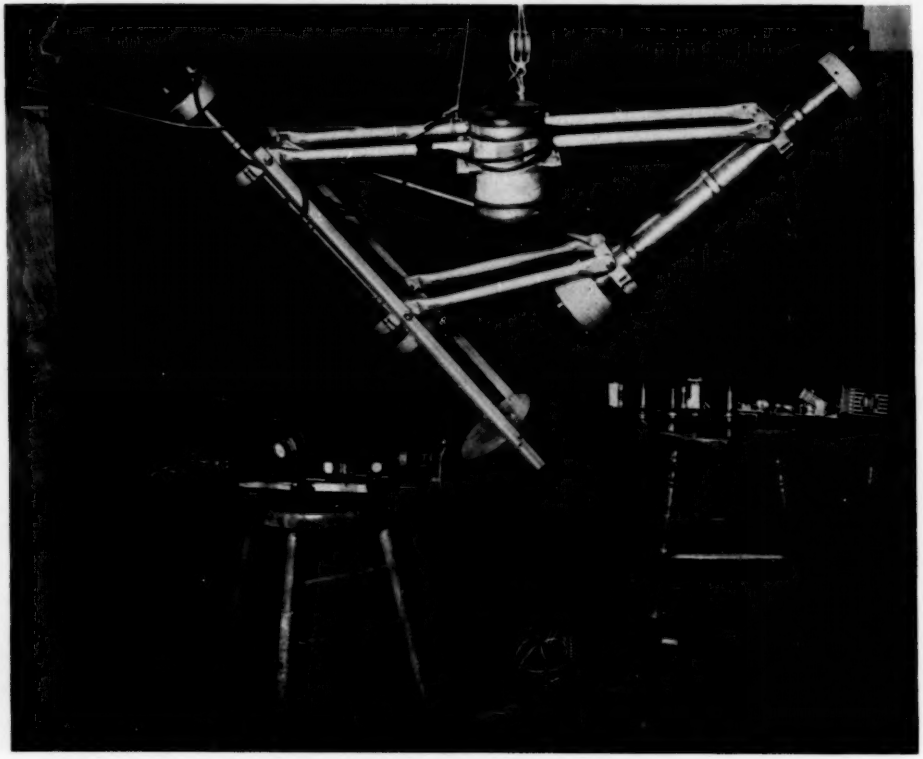


Figure 2

The entire volume of water observed by the photomultiplier lies in the field of view of the camera and is illuminated by the electronic flash. Since many luminescent animals have translucent bodies, side lighting was deemed to be most desirable. Naturally a compromise must be made concerning the field included

and the magnification of the object photographed. Since most of the luminescent animals the photographic record of which was desired were expected to be less than 3 inches in length, an observed volume of about 1/10 of a cubic foot was decided upon. A second position of the tubes in the cradle allowed the camera to photograph only half of the volume observed by the photomultiplier, but produced twice the magnification. Each time a photograph was taken both an upward and downward ray are transmitted by the sonar. By recording the difference in arrival times of these rays at the surface, the depth of the instrument can be calculated. Since it is impractical to keep exact tally of the depth corresponding to each frame for the entire length of film, a small watch in a water-tight case was attached to the device in such a manner as to appear in each photograph. By the coordination of records on a time basis, the depth, location, and other circumstances for each picture are determined.

**Mechanical Design**

The cylindrical housings for the camera and flash units as well as the end plates are made of centrifugally cast 17-4 PH stainless steel. Heat treatment after machining brought the steel to a chardness of Rockwell 41. The cylinder has an inside diameter of 4.050 inches with a 3/8 inch wall thickness and a theoretical strength of 24,000 psi. The thinnest end plate is 1 inch thick with a theoretical strength of 40,000 psi. Each of the rear end plates on both units has a single electrical lead brought through it. A gland type fitting (Conax Mfg. Co., 4514 Main Street, Buffalo, New York) is utilized in conjunction with a plastic insulated solid wire. The use of a stranded wire in the gland may result in a leak through the space between the strands if the rubber wire does not completely seal. Single prong water-tight molded plugs (Joy Co., Henry W. Oliver Building, Pittsburgh 22, Pa.) are attached to the solid wire on the outside of the end plate.

The face plate of the camera unit is 1.5 inches thick to form a rigid seat for the glass, and is provided with a 1 inch hole in the center through which the camera received light. Two concentric "O" rings form a water seal with the glass plate window. The plate glass window is 1 inch thick, and has the same outside diameter as the end plate. The surface of the glass is polished to increase its strength. The end plate of the flash unit is 1 inch thick and is provided with 1/2 inch holes spaced 2 1/4 inches apart. One of these is the receiving window of the photomultiplier and utilizes an "O" ring waterseal against a 1 inch thick plexiglass plate. The second hole is used for the connection of the electronic lamp housing.

The electronic flash lamp and associated spark coil are contained in a pyrex housing which is 12 inches long, 1 inch inside diameter, 1/4 inch wall thickness (Macalaster Bicknell Co., 243 Broadway, Cambridge, Mass.). This tube is closed with a rounded seal at one end and open with a flared edge ground flat at the other end. A metal clamp with a fiber insert fits over the flared end and secures the pyrex housing to the face end plate. A neoprene gasket provides a water seal between the flat end of the housing and the face end plate. The rubber gasket compresses under pressure and seldom has time to regain its original thickness when the instrument is retrieved. Therefore it is important to use a thin gasket and to provide some type of take-up mechanism on the metal clamp holding the tube. In this instrument the gasket

is 1/32 inch thick and there are lock washers under the clamp holding bolts to insure a tension on it at all times.

The cradle for holding the two main tubes is constructed of 1 inch stainless steel tubing. Each tube is held in place by two clamps which may be opened and closed quickly by means of a thumb screw. The sonar transducer is of the crystal-in-oil type (EDO # X-18517) employing a rubber diaphragm on each end from which sonar beams are emitted. The transducer is positioned on the cradle so that the sonar beams are directed approximately vertically up and down.

The field of view of the photomultiplier is a right circular cone of about 25° with its apex located at the face plate of the flash unit. A baffle attached to the cradle truncates this cone at a distance of 10 inches from the face plate. A sensitivity zone is thus delineated into which a luminescent animal must enter in order that its flash will trigger the instrument.

## Camera Design

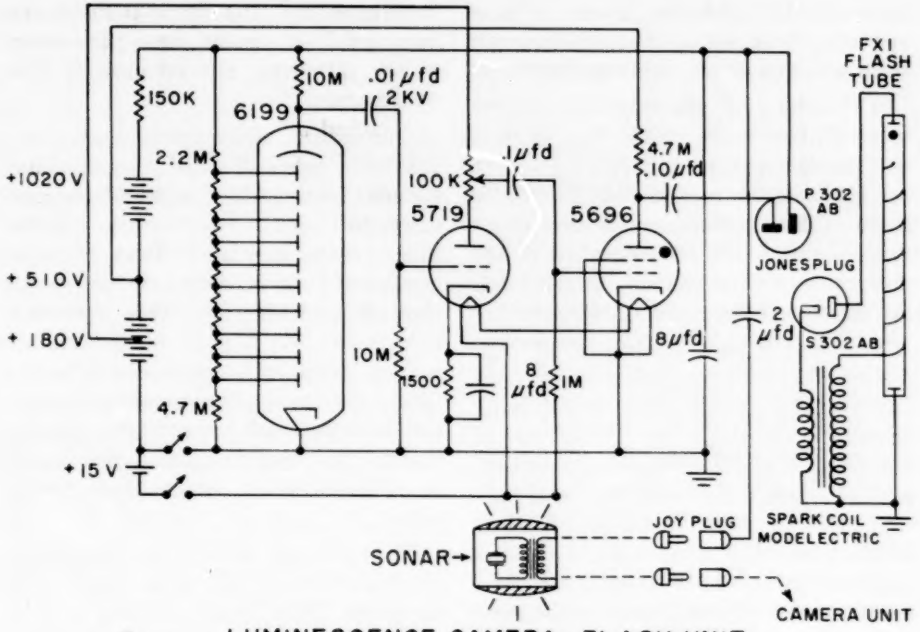
Many underwater cameras have been designed by putting a watertight case around a standard camera. Experience has shown however, that for great depths it is more advisable to design the camera to fit in the housing. The present instrument incorporates an "in-line" camera which has been specially designed by Edgerton for a cylindrical housing. The camera uses a standard 100 ft 35 mm motion picture reel. The film transportation is accomplished by using two "O" rings as belts from a motor to the sprocket shaft and to the take-up reel shaft. One main sprocket is used to meter the film. A microswitch operated by a cam on the sprocket shaft, is used to stop the film motion after each frame has been advanced. The take-up reel shaft is driven by a loose "O" ring belt that slips as the film builds up on the reel. The 6-volt motor (Hansen Manufacturing Co., Princeton, Indiana) turns at 18 rpm and is attached as a unit with the reducing gears to the camera plate.

Since the camera is shutterless, the electronic light flash takes the picture. The lens used is a Leitz Elmar f 3.5 with a 50 mm focal length. Since this lens with its adjustment cannot focus on points closer than 43 inches, lens extenders are used for each operating condition. Under "general" operating conditions the camera photographs a field 5 inches wide and 7 inches long, in the direction of the axis of the photosensitive cone. With "close up" operation the field is reduced to about half of this. Laboratory tests indicated that the most suitable aperture was f 16. The depth of field obtained at this aperture is sufficient to take in the entire photosensitive cone.

## Electronics

The circuit diagram of the photomultiplier trigger and electronic light is shown in figure 3. Photomultiplier tube R.C.A. 6199 was chosen because of its high sensitivity, convenient size, and a spectral response peaked in the region of maximum transmission of sea water, which is also probably the region of most bioluminescent emission. The photosensitive surface of the S11 type is the same as that employed in the bathyphotometer. Were this not so, it would be impossible to form any correlation between the results of the two instruments. The device will be triggered by a pulse of light as small as $5 \times 10^{-6}$ uw/cm$^2$ as measured with the bathyphotometer.

The high voltage is supplied by two 510 volt photoflash batteries (Eveready 497 or Burgess 320) placed in series.




LUMINESCENCE CAMERA—FLASH UNIT
FIG. 3

These were chosen because of their convenient size and 180 volt tap. The full 1020 volts, charging through the 150 k ohm resistor, are placed across the 8 ufd flash condenser and 2 ufd sonar condenser. These in turn hold up the voltage across the FX-1 electronic flash lamp (Edgerton, Germeshausen, and Grier, Incorporated, 160 Brookline Ave., Boston, Mass.) and the photomultiplier resistor bank. When the electronic flash lamp fires, these condensers discharge, and in so doing, drop the voltage across the photomultiplier bank to zero. This has the effect of temporarily desensitizing the photomultiplier and thus preventing it from injury by the high intensity electronic flash.

The photomultiplier resistor bank is composed of 2.2 M ohm resistors with the exception of a 4.7 M ohm resistor between the cathode and first dynode. The load imposed by this high resistance is negligible. Consequently the voltage across the photomultiplier is essentially the same as the battery open circuit voltage which makes for maximum sensitivity obtainable. Incremental voltage drops across the last few dynode resistors are of no consequence here since this is a trigger circuit rather than a linear amplifier.

The signal is developed across the 10 M ohm resistor in series with the photomultiplier anode. This very large value of resistance gives the stage a high sensitivity and serves to protect the photomultiplier from overload when subjected to a large value of ambient light. The photomultiplier generates a negative pulse across its anode resistor, whereas the thyratron can only be triggered by a

positive pulse. Therefore a stage of voltage amplification is inserted between them and this serves to invert the phase.

The voltage amplifier utilizes a 5719 subminiature triode. This tube is used for missile circuitry and is supposed to be mechanically rugged and electrically stable. These factors, in addition to its small physical size, low quiescent power dissipation, and convenient filament rating influenced the choice of this tube.

The grid resistor used is 10 M ohm which provides a high degree of coupling to the photomultiplier. This has the advantage of producing a high sensitivity, but at the same time requires that the 5719 tube draws very little grid current. All the 5719 tubes used worked satisfactorily, but since the tube is being pushed beyond the manufacturers specifications, a "good" tube might have to be selected. The plate is fed from a 180 volt tap and passes through a 100 K ohm potentiometer. The output signal, developed across the potentiometer provides the manual sensitivity control.

Thyratron tube 5696 was chosen because of its small size and low filament dissipation. The thyratron is biased to cut-off by tapping off the negative side of the filament battery. A one M ohm resistor is injected here so as to provide the high impedance necessary in a thyratron grid circuit. The plate is fed from a 510 volt tap through a 1 M ohm resistor. A .25 ufd condenser in series with the spark coil primary is placed directly across the thyratron. When no signal current is applied, the thyratron is cut off. The full 510 volts is supplied to the plate and develops across the .25 ufd condenser. When a signal is applied, the thyratron fires. The condenser then discharges through the thyratron and energizes the spark coil. During the condenser recharge transient, most of the supply voltage falls across the 1M ohm resistor. This lowers the plate voltage of the thyratron and prevents it from holding over.

One side of the spark coil secondary goes to a spiral of wire wound around the FX1 xenon flash lamp. When energized, this ionizes the xenon and serves to set off the flash lamp. Once triggered the 8 ufd flash condenser discharges through the flash lamp. This produces a light flash with a peak intensity of .4 million horizontal candlepower and a time duration of 30 microseconds. After the electronic flash has occurred, the discharge condenser requires three seconds to recharge before another flash can be made.

The resistance of the xenon flash lamp drops to a very low value when it is energized. This property allows it to be exploited as a switch. Each time the lamp flashes, a path is completed between the sonar condenser, sonar transducer, and camera recycle unit. Consequently at 12.5 Kc impulse is emitted from the sonar transducer, and a syncronizing signal is sent to the camera unit for film recycle purposes. Filament power for both tubes is provided by eight Yardney LR 1 silver cells connected in series to produce 14 volts under load. Silver cells were used because of their high stored energy versus physical volume ratio.

The circuit diagram of the film recycle unit is shown in figure 4. The synchronizing signal is developed across the 1 ohm resistor. Duration of the signal is much too short to energize a relay and must be lengthened. This is accomplished by the 50 ufd condenser and diode combination. The relay employed is of the double coil polarized latching type. When either coil is energized in the direction of the indicated polarity, it will close and remain closed until either coil

is energized in the reverse direction.

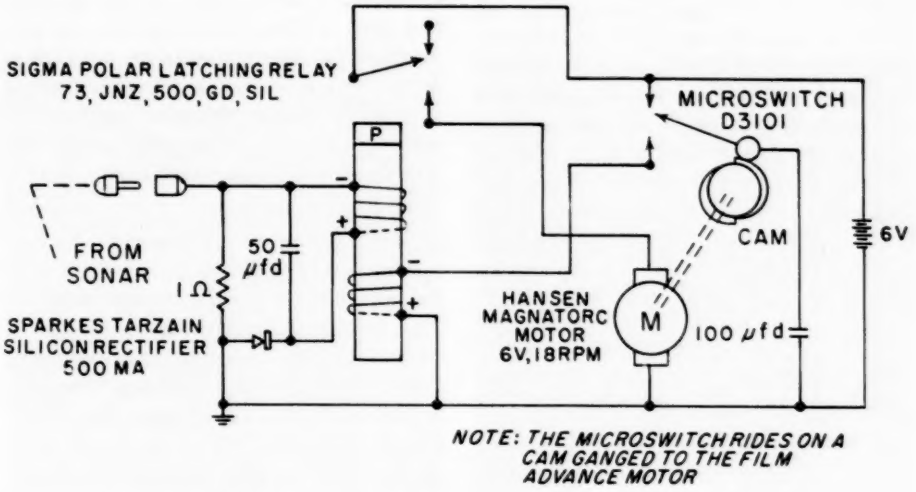
The film advance motor is mechanically coupled to a cam which activates a microswitch. The purpose of this cam is to inform the microswitch that the film has been advanced sufficiently. One six volt lantern battery (Burgess F4BP) is used to provide power for the film advance motor. This contains ample energy for the 800 recycle operations necessary to move the entire film through the camera.

At the beginning of the cycle the relay is open and the microswitch is in the down position. When the synchronizing signal is received, the relay closes and thus energizes the motor. While the motor is running, the cam causes the microswitch to assume the "up" position, and thus the 100 ufd condenser is charged. After the film has advanced sufficiently, the cam causes the microswitch to assume the "down" position, thus allowing the 100 ufd condenser to discharge into the relay. This causes the relay to open and consequently halts the film advance motor. The film is now in position, the relay has been reset, and the cycle is complete. The complete recycle process requires four seconds.

**Observations at Sea**

The luminescence camera was operated from the Research Vessel Crawford and Coast Guard Cutter Yamacraw in the waters south of Woods Hole during the summer of 1957. The instrument was used independently on certain occasions but improved results were obtained when it was employed in conjunction with the bathyphotometer and with the Precision Graphic Recorder (Knott and Hersey, 1956) for echo sounding.

The bathyphotometer used is a wide-range, logarithmic device sensitive enough to observe bioluminescence but not injured by a high intensity electronic flash. Since the light values received by the bathyphotometer at various depths are displayed on the Sanborn Recorder,




LUMINESCENCE CAMERA—CAMERA UNIT

FIG. 4

it is possible to lower the camera to regions of maximum bioluminescent activity. In addition the simultaneous use of the photometer serves to verify that the luminescence camera is operating since the occurrence of each electronic flash is visible on the record of the Sanborn Recorder.

The precision graphic recorder used is of the high-resolution, sonar type. By recording the sonar impulse emitted from the luminescence camera this device is able to discern the distance from the ship to the instrument and hence its vertical depth when the wire angle is low.

The camera may be loaded and unloaded without the use of a dark room, but opening the camera on deck causes about 3 ft. of film to be fogged. In this case about 25 frames should be run through before and after the lowering.

Open cameras at sea can become filled with warm, humid air. As a result, when the cameras are lowered into the cold sea, moisture condenses on the inside of the glass window, destroying its photographic quality. Every effort must be made to keep the inside of the camera case dry. When a camera emerges from the cold sea water, it should not be opened until it has warmed to air temperature since otherwise moisture would immediately condense over the entire interior. Thermal equalization can be hastened by bathing the camera housing in warm water.

The film used was Kodak plus X in 100 ft. spools. This was processed at sea using a Morse tank in order that the results could be evaluated immediately.

The operation of the entire instrument may be conveniently tested on deck by exposing it to a flashlight, match, cigarette, or other small light source. The electronic flash should be seen and the recycle of the film and the click of the sonar transducer should be heard.

A convenient test for the recycle circuit is to apply a six volt negative pulse between the Joy plug input and the housing ground. This technique may also be used to advance the film when desired. The electronic light section of the photomultiplier and electronic light unit may be checked by short circuiting the grid of the thyratron to ground. This should produce an electronic flash.

A portable test light was designed and constructed for facility in determining sensitivity of the instrument. This device consisted of a 700 ufd condenser charging up to 22.5 volts and then discharging through a 30 ohm rheostat into a 3 volt tungsten flashlight bulb. The light pulse generated was found to have essentially the same shape as that of many luminescent animals. A wooden calibration box was constructed. This fits over the head of the photomultiplier unit and provides a light tight chamber into which the portable test light may be introduced. The rheostat on the portable test light is then varied until the threshold of the photomultiplier trigger is found. The portable test light is then placed in the calibrating box of the bathyphotometer and its value determined by that instrument.

Sample photographs of animals which took their own pictures by means of the luminescence camera are reproduced in Figures 5 and 6. The siphonophore (about 6 cm in diameter), shown in Figure 5a, was taken in August 1957 about 170 miles east of Cape Hatteras at a depth not accurately determined but probably about 100 m. Figure 5b shows a ctenophore (about 2.8 cm in diameter) at a depth of 10 m; Figure 6a shows a medusa (about 1 cm in diameter at 100 m; and Figure 6b shows

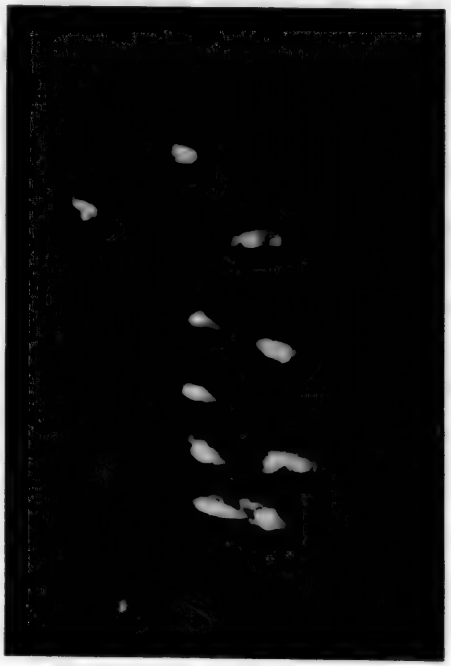


Figure 5a.

Figure 5b.

Figure 6a.

Figure 6b.

a euphausid (about 1½ cm long) at 50 m, all taken at stations north of Cuba in February 1958, after slight modifications of the camera device which will be described subsequently. A fuller account of the results obtained with the luminescence camera and their application to problems in the ecology of the deep sea will be presented in a separate report by Dr. G. L. Clarke.

ACKNOWLEGEMENTS

The authors are indebted to G. L. Clarke of Woods Hole Oceanographic Institution for his numerous suggestions as a biologist concerning the desirable features to be incorporated into the design of this instrument and for his criticism of this manuscript. We also wish to acknowledge the able assistance of V. MacRoberts of Massachusetts Institute of Technology in the construction of the instrument. L. Hoadley assisted in pressure testing of this device. The machine work was done in the machine shop of the Research Laboratory of Electronics at MIT under the supervision of foreman J. Keefe.

We wish to thank the many people who helped us during the testing of the device at sea on the R/V Crawford and CGC Yamacraw, in particular J. B. Hersey, C. J. Hubbard, W. A. Richardson, E. E. Hays, R. C. Stross, D. B. Clarke, and T. Stetson.

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# Colpophotography

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COLPOSCOPY, i.e., the examination of the uterine cervix under magnifications of 10-X to 12-X and special lighting, was introduced into gynaecological diagnostics by HINSELMANN[7] in 1924. However, until quite recently, photography of the various alterations of the uterine cervix observable with the colposcope had been practically impossible. Only during the past few years has it become possible, by using specially designed cameras or combining the colposcope with a photographic attachment, to carry out colpophotography of real value. The solution was found mainly as the result of the development of the electronic flash-lamp and the single-lens mirror reflex camera. For the historical development of the subject I refer the reader to the work of GOLDSTEIN[6]. Most works on colpophotography seem to be in German; e.g., references 1, 5, 10, 11, 15, 16, 17, 20, 21, 23, 26. However, various authors in the United States, too, have dealt with photography of the macroscopic aspect of the cervix [2,3,4,28], and with colpophotography proper[6,12,13,14,18]. WIED[27] has developed a special apparatus for stereophotography.

Our own research work, carried out over a number of years in collaboration with Dr. W. LOTMAR of the research department of Kern & Co. Ltd., Aarau[16,23,26], has culminated in the development of the Kern Colpograph. Today, our efforts have reached a certain conclusion. With a comparatively simple and inexpensive piece of apparatus it is now possible to photograph the cervix in magnifications ranging continuously from 1.1-X to 3.5-X. By adding an accessory lens the magnification may be reduced to a range of 0.5-X to 1.1-X, making it possible to photograph the cervix macroscopically, too. Other devices, added just as easily, enable stereoscopic photographs (single-lens stereos) to be taken in magnifications of 1.1 to 2.0-X.

We believe that this apparatus, which can be used for photographing not only the cervix but other parts of the body, such as eyes, teeth, changes in skin conditions, histological specimens and tables, in magnifications ranging from 0.5 to 3.5-X, is of very real value. We should like therefore to give a brief description of this apparatus and at the same time to discuss a few problems that have arisen in the course of our work.

## a. Description of the apparatus

Broadly speaking, the colpograph is a special objective, attached to a single-lens mirror reflex camera, with the addition of a pilot light for focusing the image; and in an annular discharge tube of an electronic flash apparatus, to provide illumination for the photograph. We use a Rebikoff flash apparatus with a 125-Watt-Sec output, made by Cerberus of Ragaz. The instrument (Figures 1 and 2), which is set up on the normal Kern Colposcope stand, is fitted with a

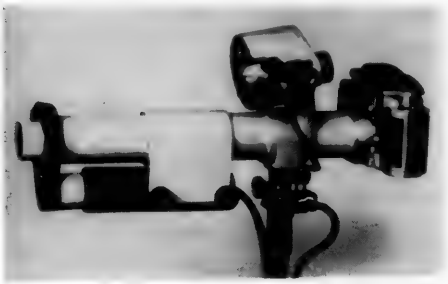

Figure 1. Kern Colpograph

variable-magnification, close-up objective. The objective consists of a movable converging lens, effective for magnifications varying between 0.57-X and 1.75-X. The real image produced by this lens is further magnified 2 X by a dispersing lens, resulting in a magnification range varying between 1.1 and 3.5-X. As the movable lens works in the neighborhood of magnification 1-X, the distance of the object from the film varies only slightly on changing the magnification. By fitting an accessory dispersing lens in front of the instrument, a range of magnifications from 0.5 to 1.1-X can be obtained as well.

For *1.1-X stereoscopic photographs* the objective is set at 1.1-X, and a tube fitted in front with a pair of achromatic wedges and a double diaphragm, is introduced into the instrument body (Figure 3). The comparatively large distance between the diaphragm and the objective provides a complete separation of the images. The stereoscopic angle of view amounts to 7° and is therefore similar to that obtained visually with the colposcope. Subsequent enlargement of the stereoscopic photographs gives a strikingly natural stereoscopic effect. This method produces a stereoscopic pair of images, each measuring 18 x 24 mm. in the normal 24 x 36 mm. frame.

With stereoscopic pictures taken at a magnification of 1.1-X, the film grain becomes somewhat disturbing when they are viewed at a magnification of 8 to 10-X. On the other hand, a smaller magnification does not allow the colposcopic lesions to be seen clearly. It was desirable therefore to take stereoscopic photographs at magnifications of 2-X, which would then be viewed at only about 4-X. This is particularly convenient as a number of good but inexpensive stereo viewers with this magnification have recently appeared on the market.

However, it is not possible with the apparatus in question to obtain stereoscopic pictures in magnifications of 2-X simply by setting the required magnification on the objective. If this is done, the distance between the objective and the double diaphragm becomes too small so that there is no longer a satisfactory separation of the images. Moving the double diaphragm forward would, on the other hand, reduce the working distance too drastically. The problem has been solved by setting the magnification of the instrument at 1.1, while the tube inserted in the instrument body acts as an accessory system with a magnification of 2-X, leaving the frontal distance unaltered (Figure 4). The place of the front pair of wedges is taken by an achromatic double-converging lens, while an achromatic dispersing lens is fitted to the rear of the tube. Figure 5 shows a stereoscopic photograph taken with such a device and subsequently enlarged to give the required pupillary distance of 60 mm.

Figure 2. Optical scheme of Colpograph for normal pictures with 1.1 to 3.5 X magnification.

Figure 3. Achromatic double wedge accessory for stereo pictures at 1.1 X magnification.

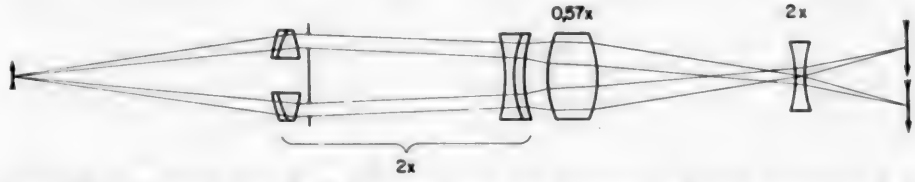


Figure 4. Achromatic front double lens and rear lens accessory for stereo pictures at 2 X magnification.

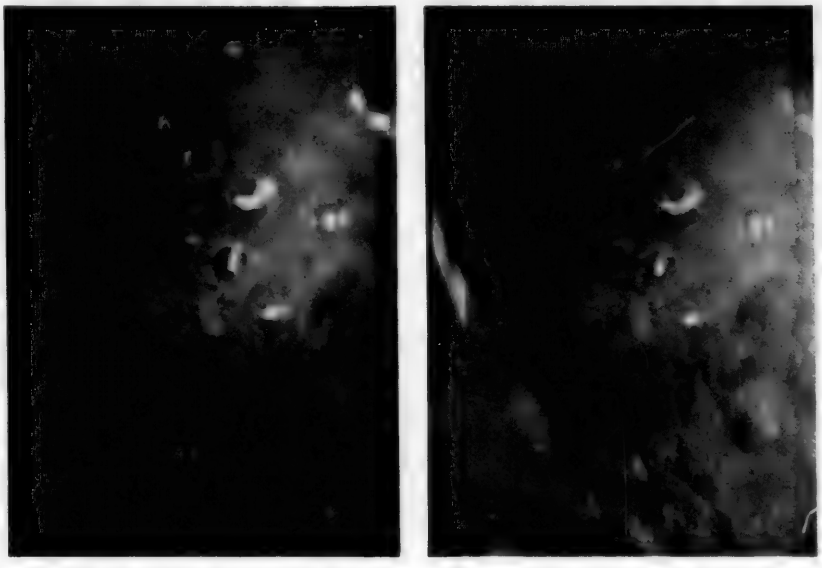

Figure 5. Stereoscopic photograph with a 2 X magnification, enlarged to 7 x 11 cm, so that the total magnification is 6.6 X and the corresponding parts of the two photographs are the optimum distance of 60 mm. apart. Photograph of the posterior lip of the uterine cervix of a patient with marked *colpitis emphysematosa in graviditate mens III* (202.15. Kodak-Panatomic-Film).

b. **Technical problems peculiar to colpophotography**

Most of today's colpophotographic apparatus is used in conjunction with a colposcope. As far as we are concerned, however, like GANSE[5] and LANDGRAF[11], we have always made it a point right from the start, of making a distinction between colposcopy and colpophotography. We are of the opinion that, as a general rule, colpophotography should be used only in certain very special cases. A systematic photographing of every cervix presented for examination could be justified only by the demands of a special scientific study; under any other circumstances it would represent an unnecessary waste of time, effort, and money. We consider that the colposcope (which should, as far as possible, be used as a matter of routine by every gynaecologist for every new examination in order to improve cervical diagnosis) should be kept as simple, convenient to use, and inexpensive as possible. On the other hand, the construction of a special instrument for colpophotographic work makes it possible to design this apparatus specifically for the purpose in hand without having to consider in any way the requirements of a colposcope. We feel that the possibility afforded by our apparatus — thanks to its complete separation from the colposcope — to vary the magnification and take stereoscopic photographs is a very great advantage.

Colposcopy makes it possible to examine the cervix at *magnifications* up to *12*-X. The main colposcopic details; such as, glandular openings, mosaic-like areas, etc., are visible only under a magnification of at least 4-X. For photographing colposcopic details, we consider a magnification of 6 to 8-X to be desirable, and even necessary. We can obtain the higher figure by enlarging a negative taken at a magnification of 2-X, to a print measuring 10 x 15 cm. (see Figures 6, 7, 8, and 11). Many alterations can be seen, however, with smaller magnifications (see Figure 10). It is occasionally desirable, particularly for beginners, to obtain an overall picture of the whole uterine cervix, which calls for photographs with magnifications of 0.5 to 0.7-X (Figure 9). The possibility of varying the magnification while taking the photographs is particularly useful when making color transparencies as it is not possible to alter the enlargement during projection and one has to decide when taking the photograph whether one wants an overall view with a small magnification or a detailed view with a large magnification.

The closest approximation to the actual colposcopic image is given by the colored stereoscopic transparency. Since projection is always rather troublesome, we prefer the use of individual viewers. In order to obtain a picture as closely resembling the colposcopic image as possible, even with simple viewers which magnify approximately 4-X, the color transparency must have a magnification of 2-X. The Kern Colpograph possesses the great advantage of fulfilling this requirement.

In colposcopy, red/white and red/yellow contrasts are most important. In black and white photography, these contrasts are sometimes artificially enhanced by using a green filter or a red-free mercury vapor

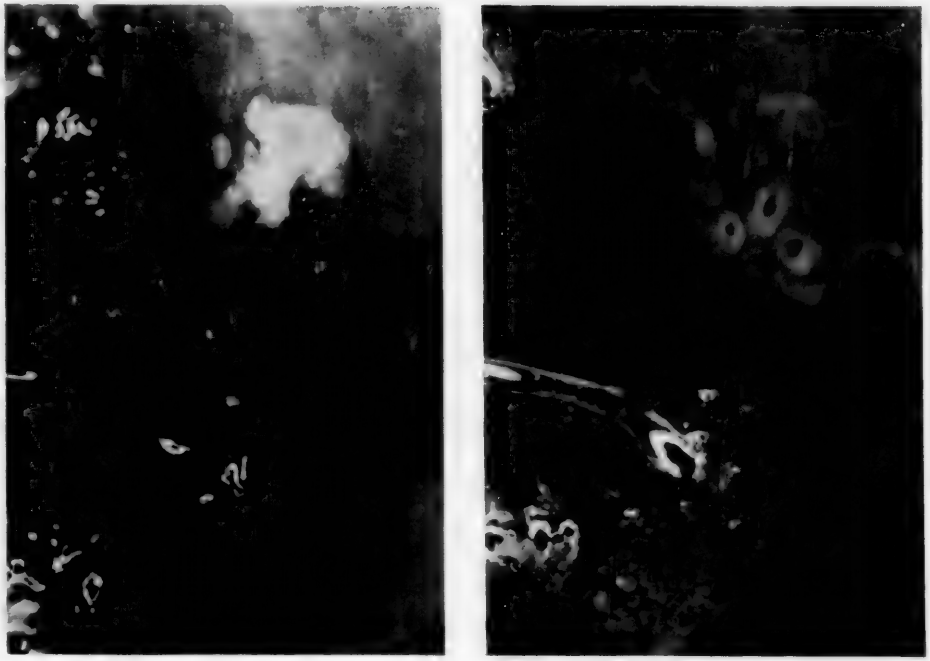

**Figure 6. Uterine cervix with fairly extensive ectopia, transformation zone, and leucoplakia. Left, cervix before treatment; right, after staining with 2% acetic acid solution.**

**A comparison of the two photographs shows how the fine grape-like papillas of the ectopia (lower half of the picture) appear much more clearly after staining with the acetic acid solution, just as do the white edges of the glandular openings in the top right-hand part of the picture. The cornified part of the leucoplakia in the top right-hand part of the picture, which is very clearly visible before staining, has been almost completely removed by the acetic acid treatment. A few superficial blood vessels were damaged by the brush and the reddish marks of the blood come out very dark on the orthochromatic Linagraph film. Magnification 2.0 x 4 = 8 X. Linagraph film (208.04/208.05).**

lamp, and orthochromatic film material insensitive to red. GANSE recommends Agfa-Fluorapid-X-ray film. We ourselves have recently been using Kodak Linagraph since it is no longer possible to obtain the Agfa-Isochrome film we had used formerly (see Figures 6, 7, and 9).

For many purposes, however, ordinary panchromatic film is quite suitable (Figures 8, 10, and 11). Color photographs can obviously be taken with either color negative or reversal films. For various reasons we generally use Anscochrome reversal films.

When using electronic flash apparatus, the brightly illuminated metal parts of the speculum inserted into the vagina may form secondary light sources, which will spoil the results. It is recommended therefore that *blackened specula* be used, on which not only the inner surfaces but also, particularly, all outer edges and screws must be blackened. The walls of the vagina also have a disturbing

effect. To offset this GALLOWAY recommends[3,4], the use of rubber sheaths fitted over the specula. Reflections can be very misleading for an inexperienced observer. A great advantage of stereo-photography is that it enables reflections to be recognized immediately as such, and does away with any possibility of confusion. *Reflections* can be avoided, as we have pointed out in an earlier work[26], by the use of crossed polarizing filters. This has the drawback, however, that the contrast of the images is poor and that the light intensity is reduced to approximately ¼. We have consequently given up trying to eliminate reflections and have found that even in plane photography they very soon cease to be any trouble to the observer.

### c. Colposcopic findings

It would be stepping outside the scope of this study if we were to go into any great detail concerning colposcopic findings. In this connection I refer the reader to other works; e.g., references 1, 9, 22, and 24. We should like, however, to discuss a few important points. For the most part, colposcopy is carried out only as a method of early diagnosis of carcinoma. It should not be forgotten, however, that the brightly focused lighting and the 10 to 12-X magnification result in a general improvement of cervical diagnosis. In ordinary consultative practice this means, in particular, a better understanding of the different forms and causes of leucorrhea. The improvement of diagnosis pertains not only to inflammatory lesions but particularly to the columnar epithelium in the form of ectopia (Figure 6) or glandular openings (Figure 7) on the outer surfaces of the cervix.

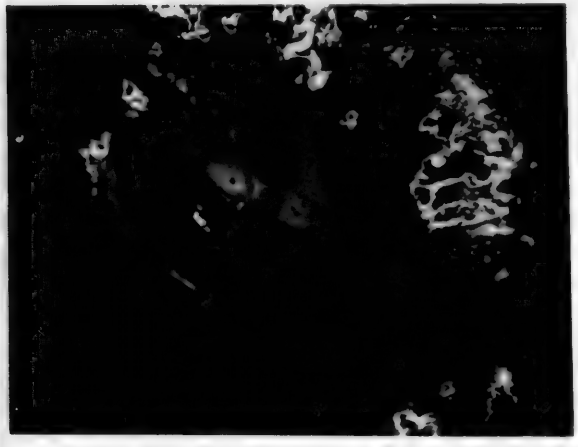

**Figure 7. Slightly transversally oval external os of the uterus surrounded by a so-called transformation zone with numerous glandular openings.**

**Photograph after treatment with a 2% acetic acid solution.**

**Magnification 2.0 x 4 = 8 X. Linagraph film. (208.23).**

Various chemicals are also used in modern colposcopic diagnostics. Of particular importance from the practical point of view is the staining of the cervix with a 2% acetic acid solution[8], which makes the ectopic columnar epithelium with its blistery grape-like papillae, or the cervical glandular openings with their whitish edges, much more easily and surely visible (Figures 6 and 7). The use of a Lugol iodine solution advocated by W. SCHILLER[19]—we use a 1% Lugol solution—stains the normal glycogen-containing multilayered squamous epithelium of the cervix uteri deep brown (Figure 8). The use of the acetic acid and iodine tests allows a large number of macroscopically suspect cervixes to be recognized as perfectly normal, the existence of a cancerous lesion being definitely excluded. The present trend in gynae-

cology is to diagnose carcinoma of the uterine cervix at as early a stage as possible before symptoms make themselves felt. In the Symposium on Applied Exfoliative Cytology held by the American Cancer Society in Brussels in July 1957, I maintained[25] that colposcopy should make it possible to reduce very considerably the strikingly large increase in the removal of tissues for cytological and bioptic examinations. Once colposcopy begins to be used for every gynaecological examination, and systematic cytological or bioptic examinations are restricted to cases that are not unmistakably normal, the number of unnecessary negative examinations will be considerably reduced, giving cytologists and histologists more time to concentrate on the examination of abnormal cases. That the early stages of uterine cancer, especially carcinoma in situ, can in fact be diagnosed by colposcopic means is evident from Figures 9-11. In Figure 11, magnification 8-X, we see the classical lesions due to carcinoma in situ, the large mosaic-like areas, the coarse punctuation and patches of leucoplakia. Figure 10 shows that these lesions are also visible even with lesser magnifications. In Figure 9 we see the result of an iodine test on a uterus that has been removed, in a contact print of an overall view with

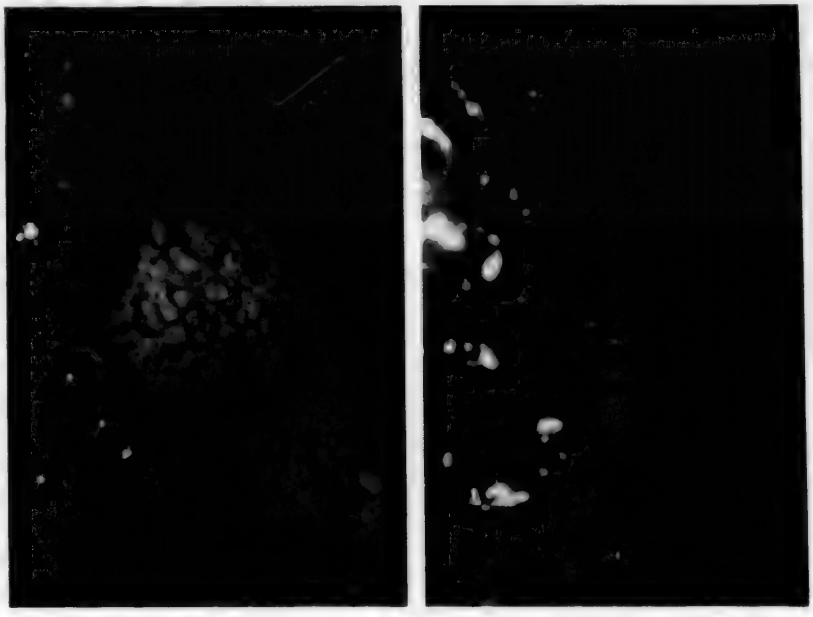

**Figure 8. So-called simple atypical epithelium producing the picture of a mosaic-like area. Left, cervix after treatment with a 2% acetic acid solution; right, after painting with a 1% Lugol iodine solution (Schiller's test). With acetic acid the atypical epithelium becomes somewhat whitish and is recognizable in this case by its mosaic-like pattern. With the iodine solution it remains uncoloured. It is separated from the healthy dark brown epithelium by a quite distinct border.**

**Magnification 2.0 x 4 = 8 X. Panatomic film. (200.32/200.33).**

Figure 9. Cervix with *carcinoma in situ* after staining with 1% Lugol iodine solution. Operative specimen of a hysterectomy. The cancerous epithelium does not absorb any colour under the Schiller iodine test, while the healthy epithelium stains dark brown. A ring of healthy epithelium is visible around the carcinoma in situ. The carcinoma in situ has consequently been completely removed and there is no danger of a recurrence. Magnification 0.6 X. Linagraph film. (208.22).

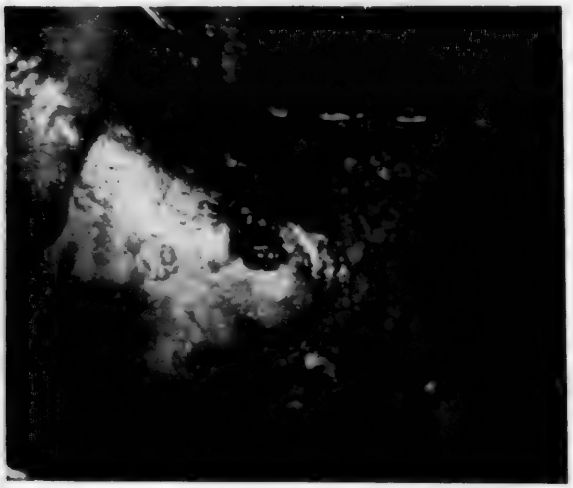

Figure 10. *Carcinoma in situ*. Same case as in fig. 9. Posterior lip of the uterine cervix with extensive mosaic-like area and leucoplakia. Photograph after treatment with 2% acetic acid solution.
Magnification 1.1 x 3 = 3.3 X. Film Adox KB 14. (204.24).

a magnification of 0.6-X. The cancerous epithelium absorbs hardly any color under the iodine test whereas the normal epithelium stains dark brown. The use of the iodine test therefore makes it easy to recognize the extent of a lesion and to tell whether the whole transformed cancerous region has been removed by the operation. In this preparation a dark ring of normal epithelium is clearly visible all around the carcinoma in situ, which has remained white. The carcinoma in situ has certainly been completely removed and the possibility of a recurrence owing to part of the cancerous epithelium's having been left behind in the vaginal cavity, can safely be ruled out.

## Summary

A description is given of a piece of apparatus made by the firm of Kern & Co., Ltd., Aarau, for photographing the uterine cervix in magnifications of 0.5 to 3.5-X, and for stereophotography in magnifications of 1.1 or 2.0-X. Various technical problems arising in colpophotography are discussed, in particular the selection of the magnification and the type of film, as well as the problem of reflections. A short account is given of colposcopy, its use, and some of the most important findings.

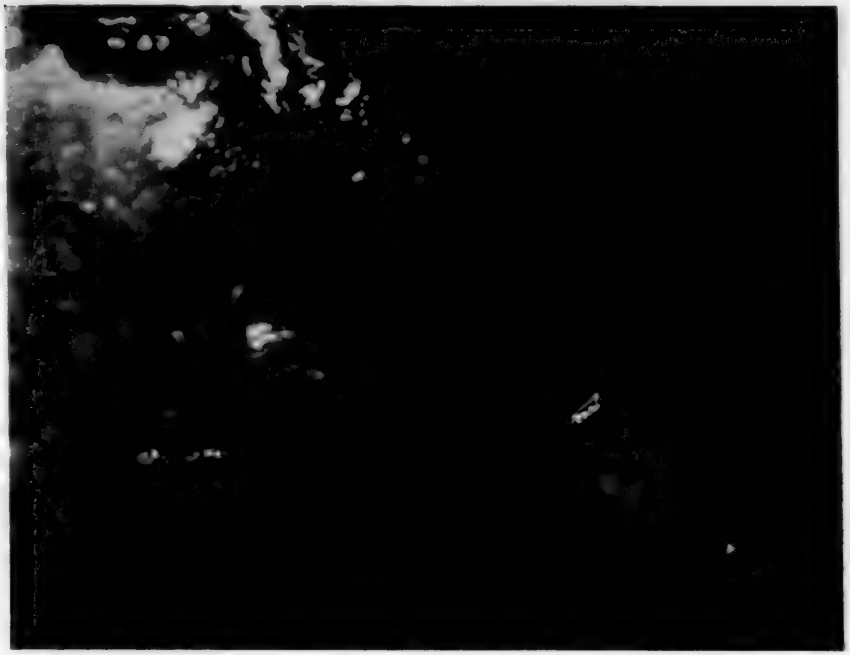

Figure 11. *Carcinoma in situ.* Same case as in figs. 9 and 10. Section of the posterior lip of the uterine cervix. With the higher magnification corresponding to the colposcopic picture the mosaic-like structure is very clearly visible.

In the posterior right-hand quarter of the picture a leucoplakia and in the front left-hand quarter coarse punctation is seen.

Photograph after treatment with 2% acetic acid solution.

Magnification 2.0 x 4 = 8 X. Film Adox KB 14. (204.21).


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# LogEtronics

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## Introduction

LOGETRONICS, the most recent contribution of electronics to photography, promises to revolutionize all phases of photographic reproduction. It now makes possible a family of photographic printers, both contact and projection, which exhibit the unique properties of *automatic dodging* and *automatic exposure* control.

High quality prints, once the product of laborious and wasteful experimental procedures, can now be obtained automatically the first time. Results comparable to those involving photographic masks[4,5,6,7] are obtained in one exposure without intermediate materials, problems of registration or tone reversal.

Early publications[1] and[2] emphasized the application of LogEtronics to commercial, industrial and aerial photography where the proven benefits become self-evident in the examples shown here. A subsequent report[3] and a paper recently submitted to the American Roentgen Ray Society* describes its utility in the reproduction of radiographs for publication, teaching, and as a diagnostic aid to the practicing radiologist. (Figure 1).

It should be noted that regardless of subject matter — a rural scene, an aerial photograph, a photomicrograph, a news photo, a radiograph, a banquet scene, an operating table — the same fundamental problems in photographic tone reproduction stem from the same sources,

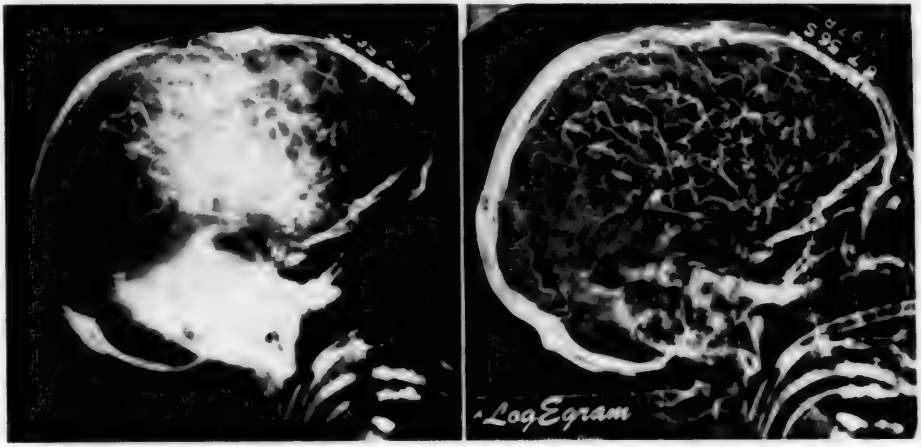


**Figure 1. A pair of prints from the same radiograph, exposed on the same materials in both the intermediate and final step. Left—the conventional print. Right—the LogEtronic print.**

*Published in ARRS Journal, July 1957, entitled "Logetronography."

namely non-uniform lighting and inherently non-linear D-LogE characteristics of photographic printing materials (usually referred to as "insufficient latitude"). Therefore, for simplicity, the ensuing discussion will be confined to the reproduction of radiographs. Also, it should be noted that regardless of the scale relationship between original and reproduction — contact, enlargement, or reduction — the fundamental problems of tone reproduction are the same and are subject to the same solution. Again, for simplicity, the following will describe a contact printer incorporating the LogEtron — a scanning, servo-modulated light source for photographic printing.

**Basic Principle**

The LogEtron uses a single cathode ray tube as the printing light source, a pair of stationary photocells to sense the light which passes through the combination of radiograph and printing material, plus two feedback loops through which the photocells control the intensity of the scanning light source and duration of the exposure. The output from photocell No. 1 is fed back to the cathode ray tube through an A.C. amplifier which performs the dodging operation by *instantaneous intensity* control. That from photocell No. 2 determines overall level through *time* control, similar to a phototimer.

Referring to Figure 2, the cathode ray tube, whose construction is similar to that used in laboratory oscilloscopes, produces a spot of light on a fluorescent screen following bombardment by a beam of electrons. The electron beam, deflected by a pair of triangular waveform voltages, causes the spot to move about the face of the tube so as to scan a rectangular area. Light from this scanning spot is projected by a simple lens through the radiograph, where it exposes the printing paper or film. Light penetrating the combination is partially collected by the photocells. Photocell No. 1 "views" the entire field, while photocell No. 2 "views" only a selected portion.

Signals from photocell No. 1 in the dodging channel correspond to density variation in the radiograph and are used to modulate electron beam intensity, and thus light output of the cathode ray tube. Signal polarity is arranged to produce inverse feedback, so that when a dense region of the radiograph is being scanned, the spot instantaneously becomes brighter, going dimmer for thin regions. As a result, an unsharp, *negative* luminous image of the radiograph is formed at the face of the cathode ray tube, and then projected back through the *positive* radiograph. The superposition produces a uniform distribution of light over the printing area, giving a uniformly exposed print regardless of wide density variations in the radiographs. The amount of feedback may be varied to achieve results ranging from a facsimile reproduction up to one having an overall grey tone accompanied by extremely high detail contrast.

Photocell No. 2 views only that portion of the field which is manually selected as the center of interest. This area, 2 inches in diameter, is then automatically reproduced at mid-scale of the printing material's density range, with other areas being exposed above and below this level depending on the residual density variations remaining after dodging.

The feedback channel from photocell No. 2 contains an integrating circuit which continuously totalizes the light passing through the selected area. After

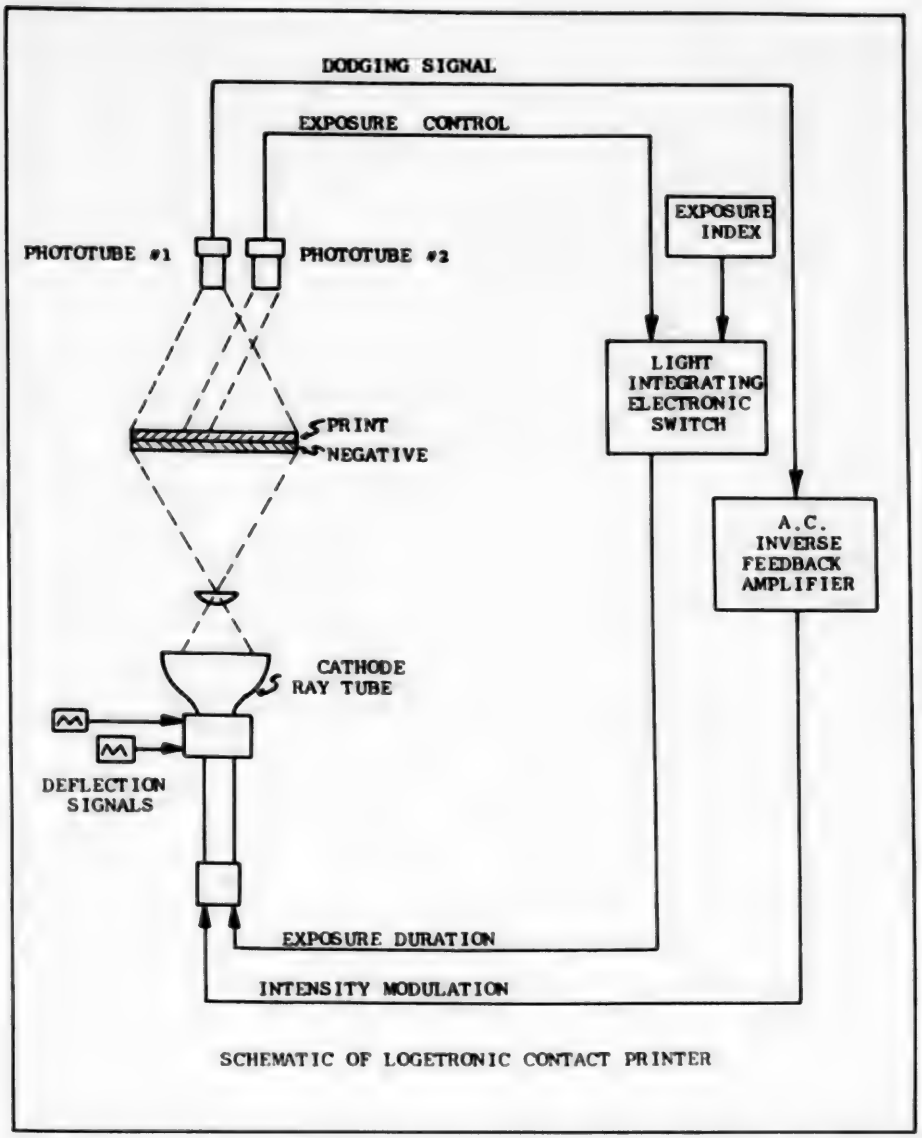


Figure 2. Block diagram of LogEtronic Contact Printer Model CP-18, showing scanning light source and two independent feedback loops for automatic dodging and automatic exposure control.

sufficient time has elapsed for the integrated light to reach the preset level (determined by emulsion speed and subsequent processing), an electronic switch automatically terminates the exposure. Although exposure times may vary from one radiograph to the next, exposure levels of the selected area will be constant since only that light which reaches the emulsion contributes to the integral. Since the integrated area is fixed, no adjustments are necessary for different sizes or average densities of radiographs.

### Scanning Pattern

The chief requirement of the scanning pattern is to provide uniform coverage of the area being printed. The pattern is generated by a pair of triangular waves of slightly different frequencies. The easiest mental picture to form of the ensuing spot motion is that of a billiard ball striking a cushion at slightly less than 45 degrees and proceeding from there ad infinitum. With this type of pattern the spot spends equal times at all positions and, with generous overlap, yields an exposure without trace of scanning lines.

### Optics

On a cathode ray tube 10 inches in diameter, the scanning pattern covers only 3 x 4 inches and must be projected up to a 14 x 17 inch area in order to cover a large radiograph. A simple lens with an f/4.5 aperture is adequate, since quality of the projected spot has no influence on resolution of detail. When projecting to 14 x 17 inches, the scanning spot is approximately ½ inch diameter. When printing smaller sizes, a different lens can be used to obtain a scanning spot as small as 1/16 inch diameter, giving better "dodging resolution" (independent exposure of smaller areas).

Optics of the printing stage are conventional, the radiograph resting on glass with the paper or film held in intimate contact by a transparent plastic air bag attached to a latching platen.

Light for photocell No. 1 is collected by diffuse transmission through the printing material, while that for a photocell No. 2 is directed from a lens and moveable mirror combination through a restricting aperture.

### Spot Size

If the spot were infinitely small, the final exposure would be a uniform grey expanse completely devoid of image. However, the spot (being finite) is sufficiently large in the printing plane to avoid this effect. Spot diameter (approximately ½ inch when printing 14 x 17 inches) is large compared to most detail in the radiograph, but small compared to total frame size. This provides good dodging resolution, allowing both "shadows" and "highlight" areas to be exposed independently, bringing out maximum detail in each.

### Photographic Effect

Paradoxically, the photographic effect of dodging is to decrease and to increase contrast simultaneously. *Gross contrast decreases* while *detail contrast increases.* This is best illustrated in Figure 3, which shows the response of a typical photographic emulsion to light — a plot of resulting density versus logarithm of the exposure, or its D-LogE characteristic.

In an ordinary print, highlight and shadow regions within a radiograph would be printed at opposite extremes of the density scale, where the slope of the curve is flat (low contrast) and detail merges with its background. However, these same two regions in a LogEtronic print are reproduced near

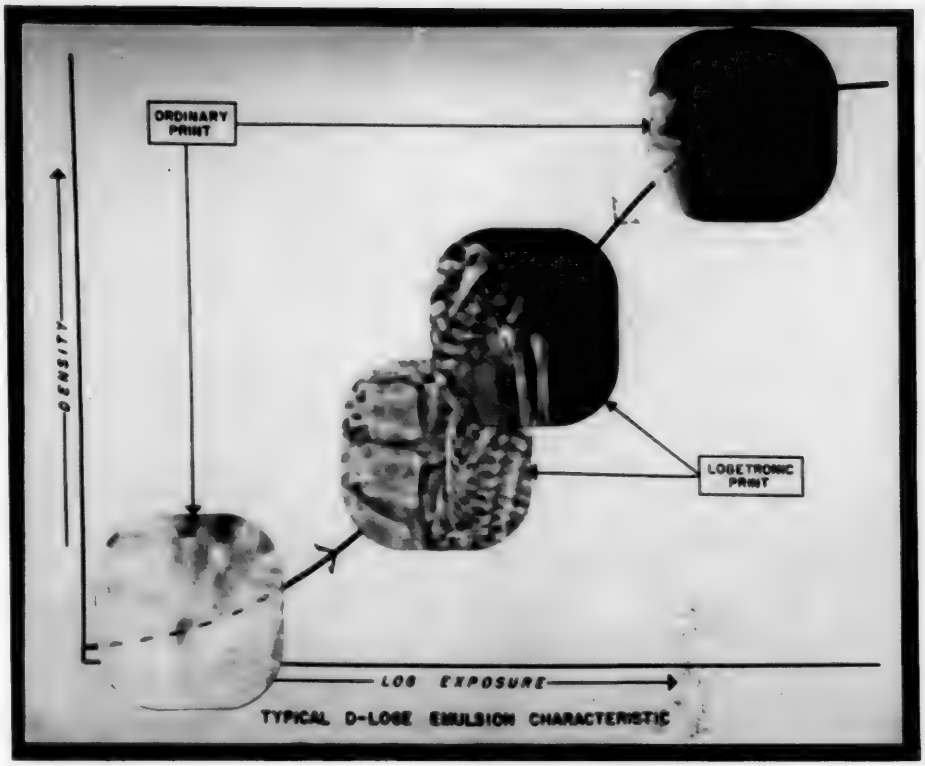


**Figure 3. Typical emulsion characteristics with corresponding sections from two different prints superimposed on the reproduction curve. Sections from the ordinary print, exposed at the extreme ends of the characteristic, exhibit low detail contrasts as a result. Sections from the LogEtronic print, exposed at mid scale, not only match in average density but also exhibit much higher detail contrast.**

mid-scale where the curve is steep (high contrast). Hence, by bringing the two regions closer together in average density, gross contrast is reduced while detail contrast is maximized, resulting in better visualization throughout.

## Operation

Operation of the LogEtronic Contact Printer, Figure 4, is relatively simple, since both dodging and exposure control are automatic.

First, an intermediate transparency is made on single emulsion film from the original radiograph, exposed in the printer, and processed in standard solutions. Then, by the same procedure, a final on paper or film is made from the intermediate.

In both exposing steps the operator selects the center of interest of the radiograph, inserts the printing material, sets the precalibrated EXPOSURE INDEX DIAL for emulsion speed of the printing material, lowers the platen, which starts the exposure, and waits (10-60 seconds) until the PRINTING light indicates automatic termination of the exposure. Radiographs from 8 x 10 inches to 14 x 27 inches or sec-

Figure 4. Photograph of the LogEtronic Contact Printer Model CP-18. Control panel is at top, printing stage at waist height, with access door in front for adjustment of the optical path.

tions down to 4 x 5 inches may be printed without recalibration. The exposed material is then processed in accordance with the standard procedure which produces the desired detail contrast for the subject and/or ultimate use of the reproduction.

## Variations

Although the usual end-product from the LogEtronic Contact Printer is at the same scale as the original, existence of the intermediate transparency permits numerous variations in the final step in terms of scale and materials. For example, a reduced copy of the intermediate on glass, paper, or film can be made in one step with conventional equipment, for slide projections, microfilming, medical display, or economical large-scale dissemination — all benefiting from improvement in the intermediate.

## Summary

The LogEtron, a radical departure from conventional printing light sources, is rapidly becoming recognized as the key to that previously elusive combination, quality plus economy, in photographic reproduction. Using the familiar electronic concepts of scanning and instantaneous inverse feedback, the LogEtron simultaneously supplies the exposing light which leads the way to automatic dodging and automatic exposure in photographic printing.

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Journal of the Biological Photographic Association Vol. 26, No. 2 May, 1958

# A Simplified System for Gross Photography, X-ray and Other Copy

JOHN E. WITHEE, FBPA

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AT the Hitchcock Medical Center photography is geared to offer rapid service to the doctor, in the clinic office, at the hospital bedside, and in the production of the prints and slides. This type of service has inspired certain technique short cuts, some of which have merit. In the methods to be described, it is believed that we have attained a superior product at a saving of valuable time.

This routine, which has been in active use here for over twelve years, incorporates a fluorescent tube "light box", colored paper for backgrounds, cork boards for a special tissue pinning process, and specially prepared paper rules. There are also other uses for the light box which will be described.

The light box is a unit made of half-inch wood 20″x24″x12″, having a full open bottom and a partially open top. Inside the box top and surrounding the partial, 11″x13″, opening are four 15″ daylight flourescent tubes. The wiring, transformers, and starter are enclosed, leaving only tubes and starter tops exposed. Through this opening on the top of the unit the camera is focused upon the ring-lighted objects placed at the level of the full open bottom of the box. Attached to one lower edge of the box are a pair of loose-pin hinges whose second leaves are attached to a sturdy base 24″x26″x11″, Figure 1. This base provides the platform for specimens. The hinged box is raised to a balance-point-stop for easy placement of objects on the platform base, Figure 2-3.

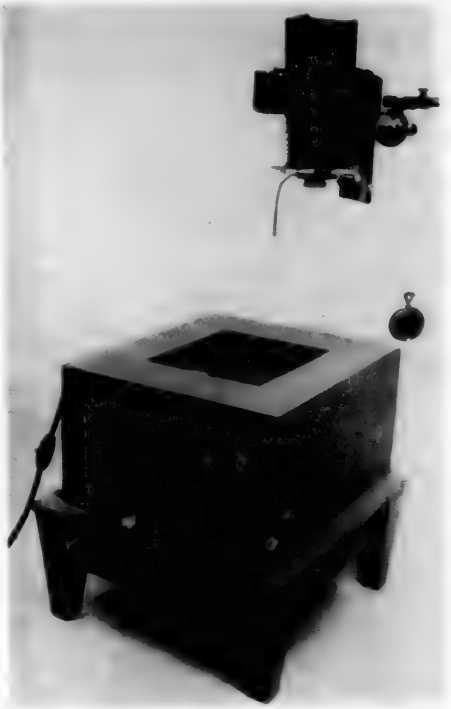

Figure 1. Light box and camera in position for use. Loose pin hinges have one long pin connecting both hinges. Wedge shaped piece between hinges holds raised box at balance point. Mirror permits easy setting of lens diaphragm at aperture shown on camera bed.

Figure 2. Open box in position for receiving specimen or copy. Note how lamp wiring is concealed in box top around opening.

The next item to be described is the background material. We use heavy, inexpensive paper, of the type called Art or Construction paper, which is available in many colors and shades and in sizes to suit. The 9″x12″ and 18″x24″ sizes have been satisfactory. Our preference is for a gray tone, with sometimes the familiar blue color. These papers have good absorbency, do not wrinkle and have a matte finish. The paper chosen is placed on a piece of cork board which then serves as a means for moving the specimen from the table to the light box.

The specimen, which has been trimmed of excess material and blotted with waste cloths, is then carefully positioned on this paper background-cork board. At this point most specimens, except for the rule, described below, are ready for photography. However, the great value of the paper-cork system becomes obvious when a difficult specimen is to be photographed. Such specimens might include sectioned hearts, bladders, intestine, in short any specimen which does not lie easily in the desired position on the background.

In these situations we employ common pins or bank pins of various lengths, driving them through the tissue and paper into the cork. We do this without concealing the heads of the pins and without distorting the specimen, Figure 4. The pins may hold cavities open or hold up drooping parts by pinning through, or support them

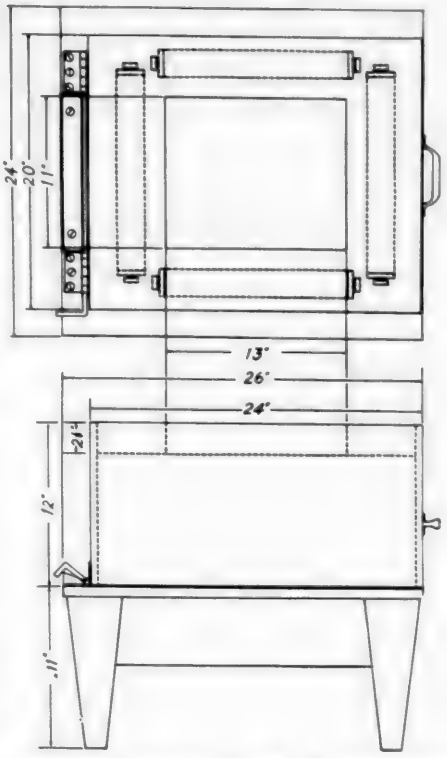


Figure 3. Construction detail is shown without wiring, which is standard for these lamps. One-half inch plywood has been used on newer models made here.

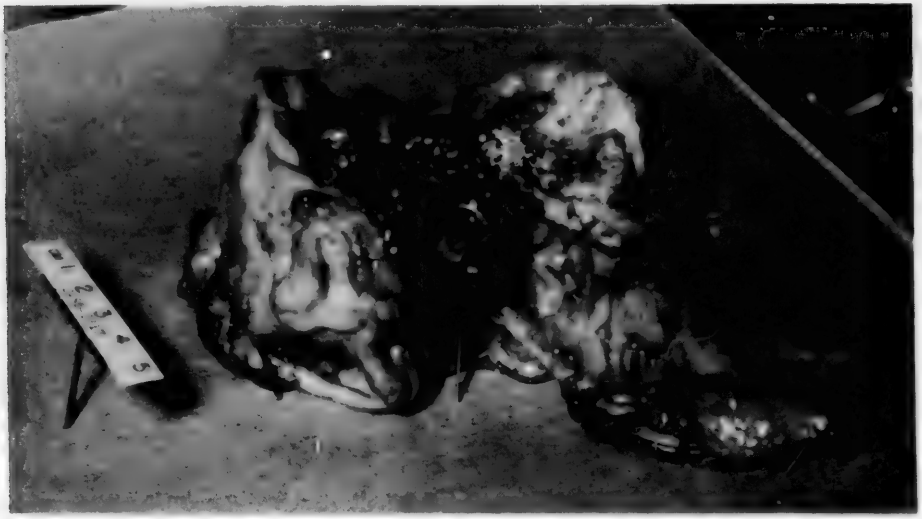

**Figure 4. Layout of one specimen to show: 1, pinning method; 2, absorbency of papers; 3, placement of rule for thick specimens; 4, use of surgical number for identity.**

by resting the specimen on previously pushed pins. With the specimen now held in a revealing position, satisfactory to the pathologist, we next clip the exposed portions of all pins, using good pin or nail cutters. Specks of tissue or debris conceal noticeable cut surfaces of pins. The specimen is now ready for the placing of the rule, indicating the scale and indentifying number.

We use rules printed to a dark gray on waterproof photographic paper from four gang negatives, each designed to best suit specimen size, Figure 5. They are in 2cm, 5cm, 8cm, and 12 cm sizes on 8″x10″ Rapid Resisto paper. This permits us to quickly type the specimen identification number on the rule, following which the individual rules are scissored from the sheet.

Placement of the rule is important. It must always appear at the bottom edge of the properly oriented specimen picture. This may involve simple placement on the background paper or it may mean a bit of pin support on a specimen which extends beyond the picture format. Thick specimens require the rule to be supported in the correct plane. This again is easily accomplished with the use of the cork board. A long pin or paper clip support is placed at an angle which precludes revealing the support to the angular view of the camera lens.

To photograph the specimen, we use a vertical camera stand and daylight color films. Other films and fluorescent tubes may also be used. In further simplifying our system we have incorporated a set of F-numbers on the lensboard of the camera which quickly designates the INDICATED F-stop which will apply at any lens extension, Figure 6. Our exposure is based on an EFFECTIVE aperture of F-22 at 5 seconds. Thus, by setting the diaphragm to the stop shown on the lensboard markers, we can always shoot at 5 seconds. In practice we increase or de-

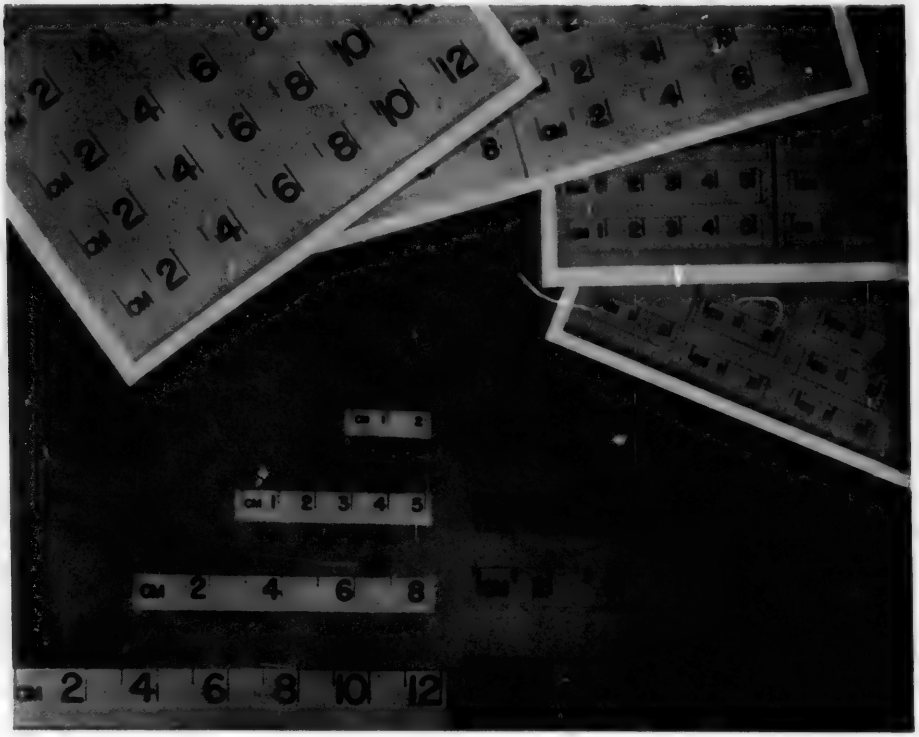

Figure 5. Four sizes of rules as printed on waterproof paper. Cut sizes shown on right were directly lettered on plastic and intended for re-use. Plastic permits tone of background to show through.

crease the time of 5 seconds whenever faced with darker or lighter than average subjects. The resulting photograph will be found to have a very satisfactory color balance, with specular highlights and depth, due perhaps to the "surround" lighting.

In addition to the specific use described above, this light unit has proved to be very well adapted to copy work from books and charts, providing as it does a constant amount of light. This constancy is used in shooting rapid copy shots using litho and other films and the same lensboard INDICATED system but with different timing for each film type.

By removing the loose pin from the hinges we can invert the light box and place a framed opal glass over all, for X-ray or other transilluminated copy work. At Hitchcock we have these light units in the autopsy room and in surgical pathology for shooting fresh specimens quickly. Another unit in photography serves all the purposes described.

In summary, a rather complete specialized system of photography has been described incorporating a number of innovations. Included were a light source for specimens, copy and X-ray; a pinning technique for immobilizing speci-

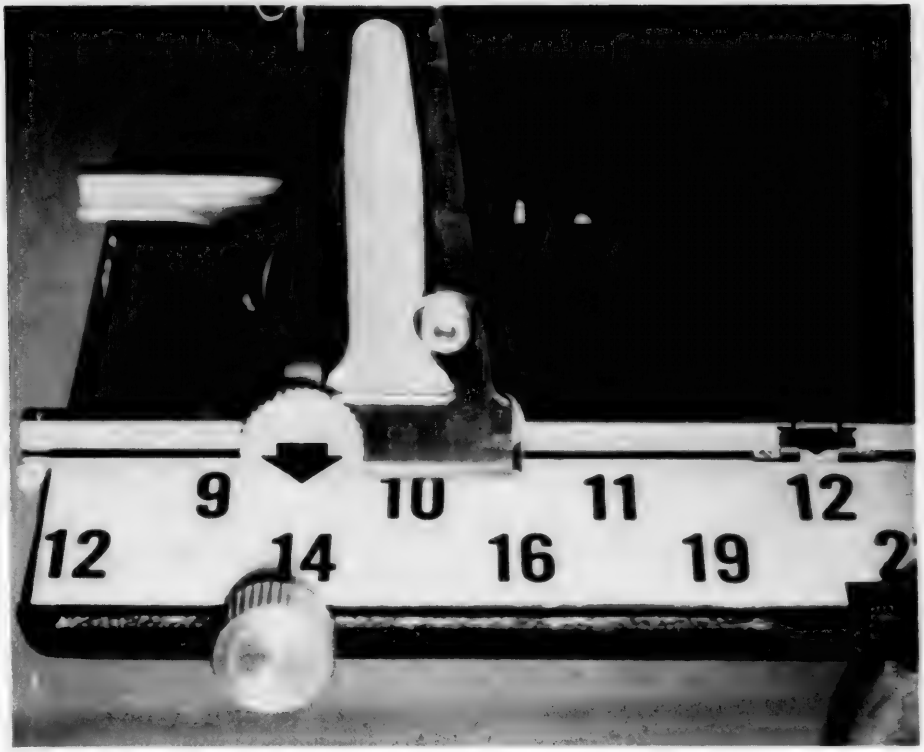


Figure 6. Camera bed label showing INDICATED APERTURE numbers. Lower row is used until lens is extended to end of bed and track (solid arrow), when lens stop (open arrow) controls further extensions.

mens; colored paper backgrounds; an aperture guide for aiding correct exposure; and a custom designed, disposable and identifying rule for specimen photography. It is felt that the whole system provides a technically correct and rapid method for both color and black and white work.

# MEDICAL AND BIOLOGICAL ILLUSTRATION

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# A Water Immersion Technique for Producing High Detail Radiographs of Laboratory Animals

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IN recent years radiographic techniques have been applied in animal laboratories with increasing frequency. Radiographs can provide a means of expedient and accurate measurements in studies which involve the skeletal anatomy of small animals such as rats, mice, and hamsters. Since normally hidden details can be visualized, the shapes and sizes of various bones can often be determined from radiographs with greater precision than by actual measurements of the specimens themselves. In this laboratory we have used radiographs of rats in the determination of such factors as skeletal maturation and density, the degree of spine curvature in certain pathologic situations, and the deviation of growing bone from its normal pattern in nutrition studies.

Many investigators have developed special techniques for producing high quality radiographs of laboratory animals. Becks and Evans[1] have compiled a complete skeletal atlas of the rat which contains radiographic reproductions of excellent detail and clarity. In their technique the rats were skinned and eviscerated, and the carcasses exposed on Eastman Type A Industrial X-ray film. Contact positives were then made of the radiographs on photographic film and from these, negative prints were made on glossy contact paper. Mortimer[2] obtained fine radiographs of skulls of rats through the use of low kilovoltage x-radiation and fine grain photographic film.

In radiographing laboratory animals, one of the chief difficulties is the selection of an exposure which provides proper penetration of the thick body parts without overexposing the limbs. This is especially difficult in the adult rat since the mass of its skeleton is very small in comparison with the mass of overlying and internal soft tissue. High contrast photographic techniques have been used to produce sharp radiographic images but reproductions of such films for publication are often disappointing.

The water immersion technique described herein is capable of producing radiographs with a high degree of clarity without the need for skinning or eviscerating the animal. In effect, radiographs made by this method show only the mineral fraction of bone without the obscuring shadows of soft tissue. Although the inorganic fraction comprises the principal absorbing mass in bone, the organic fraction ordinarily complicates the true X-ray absorption with a resulting loss of detail. However, in the water immersion technique, the bone trabeculae

stand out clearly since the absorption by the organic fraction is practically nullified.

### Theoretical Aspects

The theory which accounts for this effect is quite simple and is illustrated diagrammatically in Figure 1. A bone which contains soft tissue in its interstices (as well as being surrounded by it) is shown immersed in a shallow aluminum container of water. The percentage of x-radiation which is transmitted through any absorber can be expressed by the formula

$$\% \text{ transmission} = (I/I_0)100$$

where $I_0$ is the initial beam intensity and $I$ is the intensity after passage through the absorber. Hence in the case illustrated the immerging x-rays $I$ are those which penetrated the aluminum pan and contents. Since the x-ray absorption coefficients of water and soft tissue are nearly identical while that of the mineral fraction of bone is many times greater, the rays pass through the water and soft tissue with almost equal ease and the values of $I$ and $I_0$ are therefore nearly the same. This is in contrast to the extreme differences in absorption between soft tissue and the air which surrounds it in routine radiology. Since fat transmits x-radiation to a slightly greater extent than muscle or water, the regions of fat concentration often show faint, ghost-like outlines when the thicker body parts are radiographed. Films made by the water immersion technique show somewhat less contrast than do normal radiographs but this disadvantage is outweighed by the high degree of bone detail which is reproduced. The radiographic contrast is improved to a considerable extent by use of a high contrast photographic developer in place of the usual x-ray developer. In addition, the European custom of reproducing publishable radiographs as positives has been followed since much more of the bone detail is retained by this method.

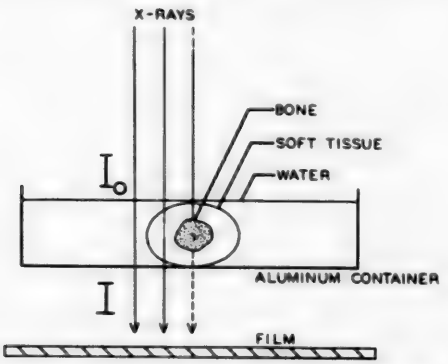


**Figure 1. Diagrammatic illustration of comparative x-ray absorption by water, soft tissue, and bone mineral.**

### Exposing and Developing Techniques

Although almost any diagnostic x-ray machine can be used, those with milliamperage ratings of 100 or higher permit faster exposures than do the small field units. The exposure technique will vary somewhat from one machine to an-

**TABLE I**

**EXPOSURE TECHNIQUES***

| Thickness of water (cm) | Kilovoltage | Ma.S | Focal-film distance (inches) |
|---|---|---|---|
| 0.5 | 43 | 100 | 30 |
| 1.0 | 44 | 100 | 30 |
| 1.5 | 45 | 100 | 30 |
| 2.0 | 46 | 100 | 30 |
| 2.5 | 47 | 100 | 30 |
| 3.0 | 48 | 100 | 30 |
| 3.5 | 49 | 100 | 30 |
| 4.0 | 50 | 100 | 30 |

*Eastman Type AA Industrial x-ray film in cardboard exposure holders used throughout. Films developed in D-11 or equivalent.

other according to its filtration and energy calibration, and a certain amount of experimentation will be necessary. The approximate exposures are given in Table I. A means of varying the kilovoltage is highly desirable in order to control penetration through different thicknesses of water; but suitable radiographs can be made with a fixed kilovoltage and varying Ma.S after some experimentation with the unit to be used.

In preparing the animal an ordinary aluminum cooking pan holds both the carcass and water and this is placed directly upon a cardboard exposure holder containing Eastman Type AA Industrial x-ray film. As shown in Figure 2 the animal is positioned in a "spread eagle" manner and secured by pieces of scotch tape across the feet.

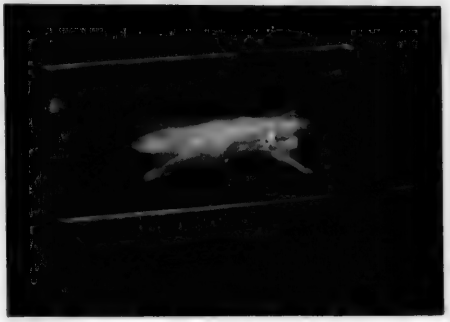

**Figure 2. The immersed carcass is positioned in a "spread eagle" manner and secured by pieces of scotch tape across the feet.**

**Figure 3. Lateral and posteroanterior views of a rat exposed in 1½ inches of water. The light areas indicate the presence of body fat.**

Figure 4. Lateral projection of amputated rear leg of a rat immersed (enlarged view) and unimmersed (inset small view).

Figure 5. Front leg and scapula immersed and unimmersed.

**Figure 6. Head of rat humerus enlarged 10 times. (Reduced to approximately ½ of the original)**

The water level should be no thicker than necessary to immerse the animal completely and any entrapped air bubbles should be stroked from the hair. In the case of thinner body parts such as the feet, legs, and tail, shallower layers of water are used.

The exposed films are tray developed for two minutes in a high contrast developer such as Kodak D-11. Normal rinsing, fixing, washing, and drying times are used. The resulting radiographs can be viewed with an ordinary x-ray illumination box with magnification, if desired, or they can be contact printed or enlarged for publication purposes.

Figure 3 shows lateral and posteroanterior views of a rat exposed through $1\frac{1}{2}$ inches of water. These were reproduced on No. 4 contact paper and were developed also in D-11. Figure 4 is a lateral view of an amputated rear leg of a rat and compares the results obtained with and without water immersion—the latter exposure showing the obscuring layers of soft tissue. Figure 5 shows the front leg and scapula. Detail in the paper-thin scapula was brought out by manual dodging. Figure 6 illustrates that enlargements of ten times or more are possible without objectionable loss of bone detail.

It appears that the water immersion technique for radiographing small laboratory animals is capable of providing films of unusually high quality when the skeletal system is being studied. A particular advantage of the system is that such resolution is possible even though the animal is neither skinned nor eviscerated. Hence the method is both expedient and nondestructive.

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# BOOK REVIEWS

**COLOR CORPORATION OF AMERICA, *Technical Information Price Catalog, Edited by Lloyd E. Varden, February, 1958.***

The 86-page catalog of the Color Corporation of America, besides description of services available from this company and complete price lists, also contains 28 pages of general and technical information about various aspects of color photography. These parts of the catalog become a practical guide to color photography and are well worth having on hand even if you never need to refer to the price pages. The headings for the general information and technical section are as follows: Some Helpful Hints on Color Portraiture; Viewing Requirements for Transparencies and Color Prints; Some Pointers on Lightbox Construction and Display Transparency Illumination Comparative Characteristics of Color Taking Films; The Limitations of Various Color Reproduction Processes; Glossary of Terms.

The Color Corporation of America is to be congratulated for making their new catalog a useful reference source on color photography. The many pages they devote to listing the services and prices for items they have available, despite how useful these data may be on some occasions, are really only incidental.

The C.C.A. catalog is so elaborate that they have put a price of $3.00 on it. But, in a note just received from Mr. Joseph S. Snyder, he has advised that any members of BPA who request a copy of the catalog on official stationery will receive a copy free of charge. L.E.V.

**TELEVISION IN SCIENCE AND INDUSTRY, *Zworykin, V.K., E. G. Ramberg, and L. E. Flory, John Wiley and Sons, New York, 300 pp., illustrated, 1958, $10.00.***

The principles of closed-circuit TV are described and the equipment illustrated by pictures and diagrams. Applications included are: distant viewing of inaccessible or dangerous locations, surgery, teaching, intercommunication, document transmission, surveillance, etc. Specific applications are described in industry, physical and engineering research, medicine and biology, education, commerce and military. There are few places from the deep sea up where no one has snooped with a TV outfit! The biological and medical uses discussed are microscopy both direct projection of the microscope image into a TV camera and the flying spot scanning technics, counting and sizing of particles, and image translation such as ultraviolet to visible light, contrast control and enhancement; area displays of skin potentials, ultrasonic ranging, radiology, diagnosis and in teaching. Diagrams of circuits are given and an occasional equation is used, although the treatment is elementary and the aim is to show the amazing use of this technic at present and to suggest new uses and applications. Most people will find something of interest, others will be informed on what closed-circuit television is doing, and we all are concerned with how it will influence and help us.— O.W.R.

**GUIDE TO THE MICROSCOPE, *Arthur Beiser, E. P. Dutton & Co., New York, 197 pp., 1957, $3.25.***

The beginner in miscroscopy will find help as to purchasing, general considerations, and what he can start to do with a microscope. It tells a little about protoza, blood, bacteria, mold, algae, cells, photomicrography, polarized light, metallurgy (actually metallography), fibers, etc., and how to look at them. It is an odd mixture of the very elementary and the technical. Latin plant names are used and the example of new modern microscopy cited is that of examining nuclear track photographs said to have started in the late 1940's! The author could well have included some of the more important advances in miscroscopy of the 20th century. Relatively few errors were found. The makers of Reichert microscopes will be amazed to locate in England rather than Vienna. While anhydrous copper sulfate will help in drying alcohol it will not, unfortunately, turn it into absolute

alcohol. This guide should be useful and appeal to children and beginners, although they will soon need more help.—O.W.R.

**PHOTOMICROGRAPHY THROUGH THE MICROSCOPE, *Eastman Kodak Company, (Rochester, N.Y.), 72 pages, 1957, 75c.***

The second edition is improved, more nearly up to date and will continue to be useful, especially for the beginner or the occasional user of photomicrography. Unfortunately, it is behind Eastman's progress in materials; Ektacolor Type L and 35mm Kodacolor have come since it was written. Data sheets are included for their M and Metallographic plates, but it would seem more useful to include data for Panatomic X and the other films recommended. Reflecting optics failed to make this edition even though they are available and easier to use than the bichromatic objective mentioned for ultraviolet. Interference microscopy also did not rate in this edition, although fluorescence and phase microscopy are included. Abbe's name is still misspelled with an accented terminal é. Like all good small books it is easy for the reviewer to ask for more. It is also too bad that Eastman policy does not give credit to the two B.P.A. members largely responsible for this excellent data book.—O.W.R.

**A SYSTEM OF OPHTHALMIC ILLUSTRATION, *Peter Hansell, Charles C. Thomas, (Springfield, Ill.), xi+114 pages, 78 figures, 1956, $5.75.***

A monograph in a single branch of medical photography by our distinguished British colleague shows that medical photography has reached maturity. Yet, chapters on the patient, on equipment, working technics for ward, operating room and studio, motion pictures, documentation and records apply generally to medical photography. The anatomy of the face, orbit and eye are described briefly with photographs, drawings, diagrams and X-ray pictures. The special cameras, instruments and lighting needed for eye photography are illustrated and directions are given for their use. Electronic flash is used to arrest motion and furnish light for color pictures, even within the eye. Most of the equipment has its counterpart, or is available in this country and only occasionally will the reader be confounded by British abbreviations.

Illustration in ophthalmology needs more than photographs and a far too brief chapter points the way to cooperation between the medical artist and the photographer.

The activity of the ophthalmic illustration department is shown by a breakdown of 11,000 requests for service. Their record and filing methods are described. References are given after many sections and a short bibliography is included as an appendix. The index is adequate.

The illustrations, some in color, amplify the text and are worthy of study by all people concerned with the eye, vision, and illustration. The medical photographer might well loan the book to some of the doctors to whet their appetite for more and better pictures. In places one wishes for more of the easily understood text, but, in this busy world, such a small book may be even more useful.—O.W.R.

**FUNDAMENTALS OF OPTICS, *Francis A. Jenkins and Harvey E. White, McGraw-Hill Book Co., (New York, N.Y.), vii+637 pages, 1957, $8.50.***

Six years ago (J.B.P.A. 20:34) the second edition was reviewed. The new third edition has its chief objectives in simplification and modernization and it is 9 pages shorter than its predecessor. This is accomplished by briefer derivations and a more compact writing of the chapter on reflection. New material includes graphical methods for ray tracing and an introduction to concentric optics.

The book is intended for a year course for advanced undergraduate students. For a full understanding some knowledge of mathematics is necessary. I believe this book will be a useful and satisfying reference for the biophotographer who wishes to know about light, optics, and what they can do. With newer methods such as phase and interference microscopy such a background is a real advantage. The section on instruments is a bit too brief for this need, although the essentials are given. The fundamentals are adequate and references lead the way to specialized and detailed sources.—O.W.R.

# Association News

● *A section of the Journal devoted to official announcements, chapter events, and other matters of historical significance to the Association.*

## GENERAL NEWS

The joint meeting of the New York and St. Lawrence Valley Chapters took place in Albany, N. Y. on March 29. The meeting was successful beyond all expectations with a registration of 130. The Spring Board Meeting was held at this time, also, and charters were granted to the Intermountain and the Pacific Northwest Chapters. This makes a total of twenty chapters.

A joint meeting of the Northern and Southern California Chapters was held April 18, 19 and 20 in Los Angeles. We hope to have a report on this meeting for the next Bulletin.

Our two B.P.A. Exhibits have continued to travel widely. "The Preparation of Photographs for Publication" was in Houston, Texas in January, Temple, Texas in February, Dallas, Texas in March. "Effective Illustrations for the Oral Paper" was in Dallas in January and Temple in February and March. Both exhibits are heading back to their point of origin in April where Verlin can give them a spring "check-up".

We have been asked by our National Secretary to inform all chapters that the word "Incorporated" or the abbreviation "Inc." is not to be used on chapter stationery, notices, etc. The preferred wording is "The . . . . . Chapter of The Biological Photographic Association".

The 28th Annual Meeting will be in Washington, D. C., August 19-22, 1958. Capital Chapter will be our host in our Nation's Capital — this is a must!!

## CHAPTERS

***Boston:*** January meeting was held at Children's Medical Center with Ferd Harding as host. The Fastex high speed motion picture camera and projector was demonstrated. Some very impressive film was shown, where one second was blown up to three minutes. In February there was a slide-making workshop with preparation of material for use in the overhead projector. Its application to medical photography was discussed. This was held at the Harvard School of Dental Medicine with L. B. Brown as host.

***Northern California:*** In January the group were guests of the San Francisco Police Department. There was a conducted tour of the "Crime Lab". February meeting was held at the Alpha Industrial Photo Supply Co. where there was a demonstration of Poloroid photomicrographs, both prints and transparencies. In March at the University of California Medical Center, Herman Adler FRMC discussed "Comparison of Microscopic Equipment, Methods and Results". Frank Skinner also presented a paper entitled "Microscopic Slide Cover Slip Thickness".

***Southern California:*** In January at UCLA Medical Center, Charles Bridgeman, Medical Illustrator at UCLA, spoke on "Some Aspects of Visual Communication in Biological Illustration". On the same program was Rudolph Sabbott of the Visual Aids Dept. who discussed "Biological Photography in the Laboratory and Afield". He had outstanding pictures of beetles, moths and butterflies. The third speaker was Alfred Benjamin who surveyed the procedures for making a motion picture of the retina. On February 20 the chapter went on a field trip to St. Joseph's Hospital in Burbank. Paul Wolfe conducted a tour of the new $30,000 photo lab and demonstrated the electron microscope. Dr. Reuben Strauss showed a time-lapse medical motion picture and a specialized surgical procedure film. Jack Whiting of the Rapid Color Print Co. discussed the importance of compatible color reproduction as applied to medical photography. The March meeting was held at UCLA Medical Center and was a discussion of the standardization of photo lab charges and it was decided to try to set up a uniform price structure.

***Capital:*** The January meeting was at the Walter Reed Army Institute. Mr. Bafford of the Neo-lith Co. of Baltimore demonstrated

Type C Color printing. In February Robert George of Towson, Maryland, one of the world's leading salonists, discussed the preparation of a print for salon entry. He also explained salon judging and showed some of his prints. The March meeting was devoted to chapter business and Mr. Marion Warren, "unofficial" photographer of the U. S. Naval Academy, demonstrated Polycontrast Paper.

***Chicago:*** January meeting was at the University of Illinois College of Medicine. Guest speaker was Mary Lela Grimes, producer and director of "Discovery", a National Educational Television show. In February the business meeting was held with election of officers. President is Louis Pedigo of the U. of Illinois; Vice-President is Leonard Hart of the West Side V. A. Hospital; Secretary is Evelyn Palmer of Mt. Sinai Hospital; and Treasurer is Charles Lindsay of Loyola Medical School. Three directors were elected: Jack DeBrinn, Frank Reindl and Dorothy Pinkham. The March meeting was a round table discussion on methods for preparing lantern slides and film strips, and Maria Ikenberg gave a short talk on the use of a ring light in closeup work for shadowless illumination.

***Central Indiana:*** The officers for 1957-58 are: President Morris Pickett; Vice-President Robert Albright; Secretary George Cave at Veterans Hospital, 1481 West 10th St., Indianapolis; Treasurer McKinley Leapley. The January meeting was held at Veterans Hospital where George Cave gave a demonstration of photography of gross specimens in stereo. A technique for reducing the interocular distance to compensate for the exaggerated illusion of depth was explained.

***Intermountain:*** Officers are: President Howard Tribe; Vice-President Max Randle; Secretary Dr. I. B. McNulty, Department of Biology, University of Utah, Salt Lake City; Treasurer Julian Maack. There was a meeting in January when Dr. Harris gave a paper "The Optics of Photography", and a film "Seashore Oddities" was shown.

***New York:*** In January the chapter was the guest of Carl Brinkmann at their new headquarters in Great Neck. There were demonstrations and discussions of the latest developments in Brinkmann, Zeiss and Polaroid cameras as well as microscopes, exposure meters, etc. Carl Windell of Zeiss showed the new Ultraphot II, a fully automatic camera microscope. All this and imported German beer too! In February, at Cornell Medical School, there was a showing of motion pictures made by members of the New York Chapter. Sam Dunton was on hand to help in evaluation and discussion.

***Pacific Northwest:*** The first quarter meeting was held in February at the Vancouver General Hospital. The meeting opened at 2 P.M. and adjourned at 6 P.M. The following officers were elected: Chairman Clifford Freehe; Vice-Chairman Kenneth Buckley; Secretary Mrs. Ada Cambern, Children's Orthopedic Hospital, Seattle 5, Washington; Treasurer Lois Wright. A scientific program followed the business meeting. There was a film clinic on motion picture production technique. Three members gave ten minute papers and a question period followed. There were three other papers: "The Practical Application of Autoradiography in Research" by Norman Dockum of Hanford Labs.; "The Importance of Photomicrography to the Medical Photographer" by George Needham of Seattle; and a demonstration on the portrait lighting and posing of men by Don Coltman of Vancouver.

***Prairie:*** In January there was a special executive board meeting as well as the regular monthly meeting in Kansas City, Kansas. The officers for 1958 are: President Margaret Ames; Vice-President Burton Johnson; Secretary-Treasurer Bernard McGinnis, 222 Hillside Ave., Topeka, Kansas. Mr. Maggard was guest speaker. He showed color travel slides and members brought their own for evaluation and criticism. February meeting was held at Winter V. A. Hospital in Topeka. Sarah Merrill discussed the use of perspective in illustration. There was a color film dealing with the basic problems of communications. Ben Bravence showed his slides from a recent trip to Phoenix. In March the group met at the University of Kansas Medical Center for a film review.

***St. Lawrence Valley:*** The January meeting was at the Montreal Children's Hospital. Charles Beddoe of the BioGraphic Unit in Ottawa was guest speaker. His subject was cinematography, especially time-lapse motion picture work. February meeting was at the Montreal Neurological Institute. Arnold Harrington and John Linder discussed color printing processes, Eastman Type C and Ansco Printon. The March meeting was also at the Neurological Institute. Guest speaker was

Douglas Anderson, chief photographer at the Forest and Insect Lab., Dept. of Agriculture. His topic was "Photomacrography of Insects and other Small Biological Objects."

***Wisconsin:*** Officers for 1958: President Anthony Kuzma; Vice-President George Spuda; Secretary-Treasurer Rita Peirick, Department of Art and Photography, Marquette University School of Medicine, 561 N. 15th St., Milwaukee 3, Wisconsin. January meeting was held at Marquette University. Fred Faust gave a demonstration of Leitz Scientific Equipment. In March the Krueger Co. was host to the chapter. There was a guided tour through their plant and an explanation of methods and techniques of color printing from the point of view of micro-color lithographers.

And how about the rest of you? Please add the name of L. B. Brown, 188 Longwood Ave., Boston 15, Mass. to your chapter mailing list. We are doing better but still not quite good enough! Thanks — see you in Washington — we hope!

L. B. BROWN, *Chairman*
*Chapters Committee*

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The American Medical Association will present a special certificate for photography that appears in the Scientific Exhibits at its annual meetings. This information was presented to the BPA Board of Governors on August 26, 1957 by Dr. Thomas G. Hull, Secretary to the Scientific Assembly of the AMA. The plan is to make the first presentation at the San Francisco meeting in June 1958. The following committee was appointed by the Board of Governors to work out procedure for putting the plan into effect: Leonard A. Julin, Chairman; Louis Paul Flory; David Lubin and John E. Withee.

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# New Products

## POWERFUL 500-WATT PROJECTOR FOR COLOR SLIDES ANNOUNCED BY KODAK

*A 500-watt big brother of the popular Kodak 300 Projector was introduced by Eastman Kodak Company at the national convention of the Master Photo Dealer's and Finishers' Association in Chicago, March 17.*

*The powerful Kodak 500 provides the utmost in slide projection brilliance in large as well as average size rooms.*

*The ruggedly built Kodak 500 has a vinyl-clad, all-steel body with die-cast end panels. The molded cover is attached with steel hinge brackets. The whole unit is handsomely styled in black.*

*Light for the big, bright picture comes from a new Westinghouse 500-watt ASA code DBJ lamp, which has the new "Focus-Lok" base for swift sure attachment or removal. An actuating lever on the lamp socket detaches the lamp.*

**The utmost in slide projection brilliance in large as well as average size rooms is obtained with the new Kodak 500 Projector. The ruggedly constructed projector has been introduced by Eastman Kodak Company.**

*For continuous cool operation, the condenser optics include a special separate heat absorbing glass.*

*Like the 300 Projector, the new 500 is available with the Kodak Readymatic Changer or an automatic magazine changer. By a simple push-pull motion, the Kodak Readymatic Changer moves the slide into projection position with a rotating movement so that slides do not tend to catch on each other. With the automatic system, slides can be permanently stored in a 36-compartment magazine. The slide advance lever positions the slide, stores it and automatically advances the magazine to the next slide.*

*The new projector can screen 35mm, Bantam or the popular new 38mm "super" slides with equal brilliance and no change in the condenser system.*

*It has a four-inch f/3.5 Lumenized Ektanon Lens and can be used with five or seven-inch lenses which are offered separately.*

*Price of the Kodak 500 Projector with Readymatic Changer is $74.50 list. With Automatic Magazine Changer, the 500 lists at $84.50.*

*The other lenses it will accept are a five-inch f/2.8 Lumenized Ektanon Lens at $20.00 list and a seven-inch f/3.5 Lumenized Ektanon Lens at $34.50 list.*

*The new projectors will be available shortly through Kodak dealers.*

## ANSCO SUPER HYPAN FILM NOW AVAILABLE IN 120, 620 ROLL AND 35mm SIZES

*Super Hypan, a new finer grain, super-speed black and white film, is now available in 120, 620 and 20 Exposure 35mm sizes according to Robert Sonnen, Marketing Manager, Amateur Products, Ansco, Binghamton, New York.*

*Although Super Hypan has an official exposure index of Daylight 500 and Tungsten 400, it may be exposed at indexes up to 1000 Daylight and 800 Tungsten or higher. This speed flexibility makes Super Hypan ideal for all types of picture taking . . . low-level, existing-light candids, scenics, portraits and stop-action photography.*

*Ansco Super Hypan marks the beginning of a new era in film design. This one remarkable film, now available in both Amateur and Professional sizes, combines exceptional speed with smooth fine grain, excellent definition, panchromatic sensitivity, gradation con-*

trol through processing manipulation and low fog level even with forced development.

The smooth grain of Super Hypan is considerably finer than that associated with traditional high speed films and compares favorably with that of medium speed films.

Prices are as follows: 120, 620 Rolls $.60
35mm $.90

### NEW, EXAKTA MAGAZINE NOW AVAILABLE

The new EXAKTA MAGAZINE, Winter-Spring 1958 issue, is the first in the new series. It contains articles by such outstanding photographers as Yolla Niclas, on how she photographed the pictures for her book, "David and the Sea Gulls", an interview with Morris H. Jaffe on his opinions and comments relating to an Exakta telephoto lens, an article by Peter Basch on Glamour Photography, a description of the new Automatic Exakta IIa, a practical report on the use of filters in order to prevent overexposure, by George Andrews, and several Exakta pictures that received commendation from Exakta Camera Company.

The EXAKTA MAGAZINE will be mailed to registered owners of Exakta and Exa cameras at no charge. Sample copies of the EXAKTA MAGAZINE will be made available to all camera owners who write to the company for it.

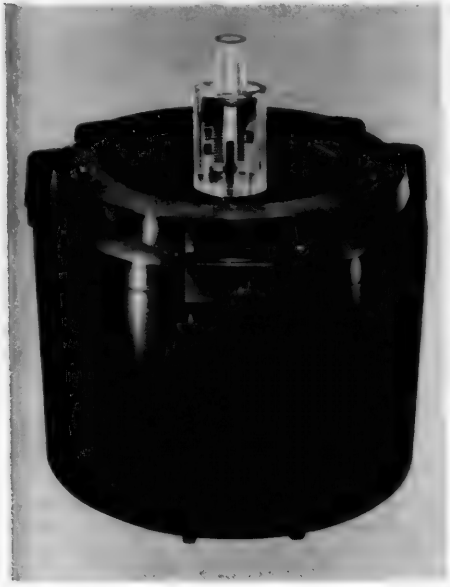
Exakta and Exa owners are invited to submit articles and photographs to Exakta Camera Company for consideration. Articles and pictures selected for publication in the EXAKTA MAGAZINE will be accepted at regular Exakta rates. Exakta and Exa owners who did not register their cameras with Exakta Camera Company are urged to do so immediately if they want to receive this and future issues of the EXAKTA MAGAZINE.

Only a few twists of the wrist are required to thread the film on the new exclusive self-loading reel. Hands need never touch the film while loading.

The Anscomatic Tank is designed with color in mind. It accommodates the new economical 16 oz. color developing outfit for Anscochrome Film which provides enough chemicals to develop five rolls of 20 exposure 35mm or three rolls of 120/620 or the equivalent. A clear upper flange of the self-loading reel permits second exposure for color without removing the film from the reel.

The self-loading reel of the Anscomatic tank adjusts easily to accommodate loading 120, 620, 127, 828 rolls or 35mm.

The tank sells for $5.95.



A new 16 oz. Anscomatic Film Developing Tank is being introduced by Ansco, Binghamton, New York.

### NEW SILVER RECOVERY UNIT IS ANNOUNCED BY OSCAR FISHER CO.

In the past, the practical operation of a silver recovery unit was confined largely to photographic labs where the amount of film processed was of such proportions as to warrant the outlay of a large sum of money for expensive equipment.

The new Model 0-57 Silver Recovery Unit manufactured by the Oscar Fisher Company, Inc. of Newburgh, N. Y., performs its functions electrolytically at a cost reported to be only 2c to 3c per hour, and gathers silver at the rate of one ounce per hour.

The Oscar Fisher Company who engineered and designed this low-cost apparatus, have turned their efforts to produce a unit that will fit the needs of the average processing lab. The Model 0-57 Unit has been under test and has been proved practical and reliable in the recovery of pure silver from photographic fixing solutions. An additional advantage is the fact that the fixing bath lasts up to five times

longer when the unit is used with proper replenishment to maintain the acidity of the fixer.

With the present value of silver being about $1.00 an ounce, the value of silver recovered by this unit, at the rate of one ounce per hour, based on an eight hour day, for 36 days,

would make this unit pay for itself in a relatively short time.

Now, for the first time photographic processing laboratories can avail themselves of a compact and complete unit employing the very same principle of agitation prevalent in the design of much larger and more expensive equipment. Operation is simple and fool-proof and only requires being plugged into a 110 Volt A.C. electrical outlet. The Fisher Silver Recovery Unit is virtually automatic and may be left to operate during hours when the laboratory is left unattended.

The thought of space was carefully considered in designing the new Silver Recovery Unit. The five gallon stainless steel tank, with its clear Lucite cover, containing the rotation graphite electrodes measures only 14" in diameter and 14" in overall height. The control box can be mounted on the wall or placed on a shelf, while the Fisher stainless steel centrifugal pump can be hidden to operate out of sight.

### NEW KODAK DATA BOOK ON THE PHOTOGRAPHY OF GROSS SPECIMENS AVAILABLE

A new booklet which describes special requirements for photography of gross specimens has been prepared by the Medical Division of Eastman Kodak Company. Titled, "The Photography of Gross Specimens," the 24-page, full-color booklet outlines in detail the equipment, sensitized material, types of background, preliminary planning and camera technique recommended for photography of gross specimens.

In recent years, photography of gross specimens has proved particularly helpful in teaching, illustration of technical papers, case discussion at staff conferences, exhibition before professional and lay groups and supplementation of case histories.

Eighteen full-color illustrations and numerous black-and-white diagrams, charts and photos are used to present pertinent technics, such as lighting, focusing, exposure, film data, filters and preparation of the specimen.

"The Photography of Gross Specimens" may be obtained from Kodak dealers at a cost of 75 cents.

### "POCKET DARKROOM" FOR COLOR FILM NOW AVAILABLE

A new Anscochrome color film Easy-Loader combination offer, which permits the budget-conscious color photographer to load the popular 35mm Anscochrome color film at considerable saving, has just been announced by Mr. Robert W. Sonnen, Marketing Manager, Amateur Products Section, Ansco, Binghamton, New York.

The new Easy-Loader combination for the first time includes a package of 8 new empty cartridges. Color photographers now have available for on-location use a "pocket-size" color film loading darkroom.

The Easy-Loader sells for $9.95 and contains 8—20 exposure loads. The introductory price for the 8 new empty cartridges is $.69. Cartridges later will sell for $1.20 in packages of 8.

A new, compact-size rotary print dryer with deluxe features has just been put on the market for only $17.95; and this low price for a rotary dryer is surprising, indeed, considering the efficiency and convenience of this smaller size unit. Known as the LOTT DRUM-MASTER, it is a perfect addition to the famous line of LOTT rotary print dryers, manufactured exclusively by U.D.A. Inc., St. Louis, Missouri.

The LOTT DRUM-MASTER is 8 inches high by 12¾ inches long and, therefore, occupies only very little space. The small size and the low price of this quality dryer make it an ideal piece of equipment for the amateur

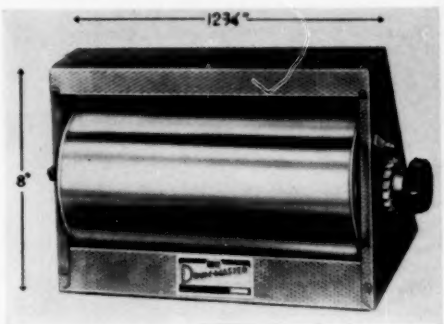
*who is just setting up a darkroom. And, for the professional who wants quick drying on a small photofinishing job, the DRUM-MASTER is proving itself extremely versatile.*

*Although the overall size of the dryer is small compared to others on the market, the drum itself is big enough to accommodate an 11 x 14 print, or two 8 x 10s, four 5 x 7s, etc. As with all LOTT dryers, the drum is stainless steel with a mirror finish.*

*The DRUM-MASTER is remarkably light in weight for greater convenience and portability. It has a non-rust aluminum frame that is attractively diamond-embossed.*

*It dries matte or glossy prints in 5 to 7 minutes; a pre-shrunk canvas belt holds prints flat against the drum while drying. The DRUM-MASTER uses 125 watts on 115 volt AC or DC, and the heating element is guaranteed for 2 years. Shipping weight for entire unit, complete with 6 foot heavy-duty cord, is 5 pounds.*

*At the remarkably low price of only $17.95, this fine quality rotary dryer will undoubtedly introduce thousands of fans to the fun of home photofinishing. For further information, write U.D.A. Inc., St. Louis 10, Mo.*

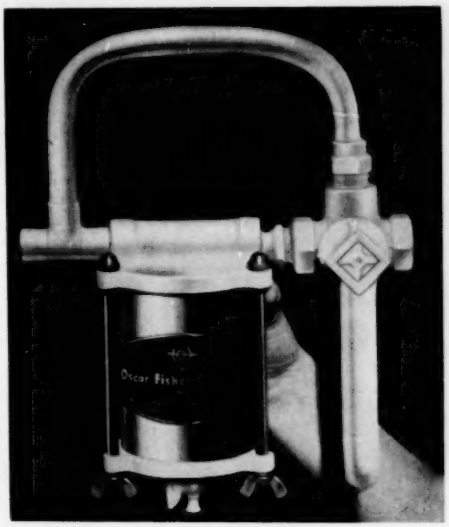



### *NEW FISHER MICROFILTER DELIVERS 10 GALLONS PURE WATER PER MINUTE*

*Designed primarily to meet the needs of industrial, professional and commercial photographers, the compactly engineered Fisher Microfilter lends itself to numerous uses wherever positive filtration is required.*

*In designing the new Microfilter, the Oscar Fisher Company of Newburgh, New York, have done away with all screens and pads, and have installed a permanent type filter element employing the new sintered metal principle. The Microfilter can be cleaned by reversing the flow of water momentarily, this is accomplished by a simple twist of the wrist and does not necessitate the stoppage of any work.*

*The Fisher Microfilter is an all-metal filter, easy to connect by using standard half inch pipe fittings. It has a three-way reversing*



*valve and a handy petcock to facilitate flushing. The permanent filter core is housed in a brass cylinder. Where larger quantities of water are required, two Microfilters can be installed in series. When this is done, twenty gallons of filtered water are delivered instead of ten.*

*Filter cores for the Fisher Microfilter are available in several degrees of fineness, the standard unit is equipped with a 2 - 4 micron filter. Unit dimensions are: Height—10½", Length—8½", Width 4". Shipping weight is eight pounds. The Microfilter, like all other Oscar Fisher products, is fully guaranteed for one year against faulty workmanship and defective material.*

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## FELLOWSHIP PROCEDURE

Members may propose for Fellowship in the BPA other members whom they consider worthy of recognition. To be eligible for Fellowship a candidate must have been a member of the Association for five consecutive years and must possess one or more of the following qualifications:

Superior craftsmanship in still or motion picture photography of biological subjects.

Ability in photographic research in new methods or materials.

(These require submission of evidence.)

Meritorious contributions to biological photography overall through sustained organizational work.

Two sponsors are required. The sponsors should be well acquainted with the candidate's work and ready to furnish the Board with details of his experience and achievements. Those who wish to sponsor a member whom they believe to be eligible should request a Fellowship Application form from the Secretary of the Fellowship Committee: Mrs. Maria Ikenberg, University of Illinois, 904 W. Adams Street, Chicago 7, Illinois.

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